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STATISTICS.

STOCKS OF COPPER IN ENGLAND AND THE CONTINENT.
Reported by Henry R. Merton & Co. Tons of 2240 lb.

| | April 30 Tons | May 31 Tons | June 30 Tons |
|-------------------------------------|------------------|----------------|-----------------|
| In England | 11,519 | 12,684 | 14,721 |
| In France | 2,310 | 5,934 | 5,743 |
| Afloat from Chile | 2,500 | 1,700 | 1,650 |
| Afloat from Australia | 4,000 | 4,000 | 3,550 |
| In Rotterdam | 3,400 | 3,100 | 3,050 |
| In Hamburg | 4,452 | 3,872 | 3,477 |
| In Bremen | 1,097 | 1,080 | 1,080 |
| In other European Ports..... | 575 | 600 | 475 |
| Total European visible supply | 29,853 | 32,970 | 33,746 |

AMERICAN COPPER PRODUCERS' ASSOCIATION'S FIGURES.
In Tons of 2240 lb.

| | Production. | Deliveries | | | Stocks at end of month |
|--------------------|-------------|------------|---------|---------|------------------------|
| | | Domestic | Foreign | Total | |
| June 1913..... | 54,402 | 30,559 | 30,396 | 60,955 | 23,577 |
| July | 61,640 | 26,296 | 35,035 | 61,331 | 23,886 |
| August..... | 58,764 | 32,897 | 32,706 | 65,603 | 17,064 |
| September..... | 58,661 | 29,837 | 32,627 | 62,464 | 13,261 |
| October..... | 62,085 | 30,435 | 30,412 | 60,847 | 14,499 |
| November..... | 59,860 | 21,721 | 31,280 | 53,001 | 21,358 |
| December..... | 62,049 | 9,794 | 32,831 | 42,625 | 40,782 |
| Total 1913 | 724,307 | 342,566 | 387,974 | 730,540 | — |
| January 1914 | 58,826 | 21,409 | 39,266 | 60,675 | 38,933 |
| February..... | 54,715 | 21,244 | 37,455 | 58,699 | 34,949 |
| March..... | 65,023 | 31,184 | 39,983 | 71,167 | 28,805 |
| April..... | 67,634 | 28,315 | 36,761 | 65,076 | 31,363 |
| May..... | 63,530 | 24,818 | 32,460 | 57,278 | 37,615 |
| June..... | 63,101 | 20,637 | 32,745 | 53,382 | 47,334 |

PRODUCTION OF GOLD IN THE TRANSVAAL.

| | Rand | | Elsewhere | Total | Value |
|-------------------|-----------|---------|-----------|------------|-------|
| | Oz. | Oz. | | | |
| Year 1912 | 8,753,563 | 370,731 | 9,124,299 | 38,757,560 | |
| June 1913 | 716,267 | 30,810 | 747,077 | 3,173,382 | |
| July | 625,107 | 30,282 | 655,389 | 2,783,917 | |
| August..... | 697,686 | 30,410 | 728,096 | 3,092,754 | |
| September..... | 676,411 | 29,775 | 706,186 | 2,999,686 | |
| October..... | 687,515 | 30,916 | 718,431 | 3,051,701 | |
| November..... | 644,320 | 29,166 | 673,486 | 2,860,788 | |
| December..... | 642,786 | 30,029 | 672,815 | 2,857,938 | |
| Year 1913 | 8,430,998 | 363,826 | 8,794,824 | 37,358,400 | |
| January 1914..... | 621,902 | 29,851 | 651,753 | 2,768,470 | |
| February..... | 597,545 | 28,716 | 626,261 | 2,660,186 | |
| March..... | 657,708 | 29,093 | 686,801 | 2,917,346 | |
| April..... | 655,607 | 28,270 | 683,877 | 2,904,924 | |
| May..... | 689,239 | 30,970 | 720,229 | 3,059,340 | |
| June..... | 688,232 | 29,694 | 717,926 | 3,049,558 | |

COST AND PROFIT ON THE RAND.

| | Tons milled | Yield per ton | | Cost per ton | | Profit per ton | Total profit |
|-------------------|-------------|---------------|-------|--------------|------------|----------------|--------------|
| | | s. d. | s. d. | s. d. | s. d. | | |
| Year 1912..... | 25,486,361 | 29 2 | 19 3 | 9 11 | 12,678,095 | | |
| Year 1913..... | 25,628,432 | 27 9 | 17 11 | 9 6 | 12,189,105 | | |
| January 1914..... | 1,902,733 | 27 4 | 18 2 | 9 3 | 876,577 | | |
| February..... | 1,861,442 | 26 10 | 17 11 | 8 0 | 823,654 | | |
| March..... | 2,094,098 | 26 4 | 17 3 | 1 | 945,000 | | |
| April..... | 2,075,561 | 26 6 | 17 3 | 0 1 | 955,600 | | |
| May..... | 2,196,287 | 26 3 | 17 0 | 0 3 | 1,011,968 | | |

GOLD OUTPUT OF INDIA.

| Year 1912 | Year 1913 | June 1914 | Year 1914 |
|------------|------------|-----------|------------|
| £2,265,094 | £2,299,315 | £192,224 | £1,144,953 |

PRODUCTION OF GOLD IN WEST AFRICA.

| Year 1911 | Year 1912 | Year 1913 | May 1914 | Year 1914 |
|-----------|-----------|-----------|----------|-----------|
| £ | £ | £ | £ | £ |
| 1,069,442 | 1,497,179 | 1,634,700 | 145,227 | 660,347 |

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

| | Gold mines | Coal mines | Diamond mines | Total |
|-----------------------|------------|------------|---------------|---------|
| June 30, 1913..... | 188,094 | 9,060 | 14,654 | 211,808 |
| July 31..... | 170,242 | 9,403 | 13,378 | 193,023 |
| August 31..... | 158,223 | 9,236 | 13,172 | 180,631 |
| September 30..... | 152,637 | 9,361 | 12,321 | 174,319 |
| October 31..... | 148,882 | 9,377 | 12,712 | 170,971 |
| November 30..... | 147,569 | 9,286 | 12,680 | 169,535 |
| December 31..... | 150,012 | 9,516 | 11,811 | 171,339 |
| January 31, 1914..... | 154,202 | 9,471 | 11,979 | 175,652 |
| February 28..... | 157,673 | 9,508 | 12,266 | 179,447 |
| March 31..... | 162,815 | 9,619 | 13,390 | 185,824 |
| April 30..... | 165,005 | 9,625 | 14,150 | 188,780 |
| May 31..... | 165,433 | 9,619 | 14,284 | 189,336 |
| June 30..... | 166,248 | 9,442 | 13,256 | 188,946 |

PRODUCTION OF GOLD IN RHODESIA.

| Year 1911 | Year 1912 | Year 1913 | May 1914 | Year 1914 |
|-----------|-----------|-----------|----------|-----------|
| £ | £ | £ | £ | £ |
| 2,647,894 | 2,707,368 | 2,903,267 | 290,062 | 1,368,125 |

PRODUCTION OF GOLD IN WESTERN AUSTRALIA.

| | Export oz. | Mint oz. | Total oz. | Total value £ |
|---------------------|------------|-----------|-----------|---------------|
| Total, 1913 | 86,255 | 1,227,888 | 1,314,143 | 5,448,332 |
| January, 1914 | 9,762 | 102,261 | 112,023 | 475,840 |
| February..... | 8,493 | 94,812 | 103,305 | 438,809 |
| March..... | 1,173 | 91,446 | 92,619 | 393,418 |
| April..... | 8,774 | 90,233 | 99,007 | 420,553 |
| May..... | 7,138 | 99,068 | 106,206 | 451,132 |
| June..... | 1,725 | 99,290 | 101,015 | 429,081 |

OTHER AUSTRALASIAN GOLD PRODUCTION.

| | 1912 | 1913 | June 1914 | 1914 |
|----------------------|-----------|-----------|-----------|---------|
| | £ | £ | £ | £ |
| Victoria | 2,039,400 | 1,847,400 | 180,797 | 908,897 |
| Queensland..... | 1,484,160 | 1,118,610 | 85,420 | 468,500 |
| New South Wales..... | 702,129 | 635,703 | 58,767 | 372,190 |
| New Zealand..... | 1,345,115 | 1,345,131 | 141,984 | 698,691 |

NIGERIAN TIN PRODUCTION.

In tons of concentrate of unspecified content.

| Year 1912 tons | Year 1913 tons | May 1914 tons | Year 1914 tons |
|----------------|----------------|---------------|----------------|
| 2,532 | 5,032 | 480 | 2436 |

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

Estimated at 70% of concentrate shipped to smelters.

| 1911 tons | 1912 tons | 1913 tons | May 1914 tons | Year 1914 tons |
|-----------|-----------|-----------|---------------|----------------|
| 43,967 | 48,250 | 50,128 | 4,135 | 20,599 |

SALE OF TIN CONCENTRATE AT REDRUTH TICKETINGS.

| | Tons | Value | Average |
|-----------------------|------|----------|-----------|
| Year 1911 | 6151 | £702,599 | £114 4 5 |
| Year 1912 | 6492 | £831,908 | £128 5 6 |
| Year 1913 | 6186 | £744,268 | £120 2 6 |
| January 5, 1914 | 2024 | £18,743 | £92 13 6 |
| January 19..... | 2323 | £23,045 | £96 6 6 |
| February 2 | 231 | £24,054 | £104 2 7 |
| February 16 | 2324 | £23,824 | £102 11 7 |
| March 2..... | 2342 | £22,286 | £95 2 9 |
| March 16 | 2143 | £20,726 | £96 12 6 |
| March 30 | 2299 | £21,776 | £94 17 8 |
| April 14 | 1935 | £18,251 | £94 6 5 |
| April 27 | 2209 | £19,413 | £88 0 11 |
| May 11 | 2159 | £18,485 | £85 15 6 |
| May 25 | 2279 | £19,155 | £84 4 0 |
| June 8..... | 226 | £17,767 | £78 12 5 |
| June 22 | 2034 | £15,862 | £77 19 0 |
| July 6 | 232 | £19,416 | £83 13 10 |

EXPORTS OF TIN AND ORE FROM STRAITS AND BOLIVIA.
Reported by A. Strauss & Co.

| | 1912 tons | 1913 tons | June 1914 tons | 1914 tons |
|--|-----------|-----------|----------------|-----------|
| Metal from Straits to Europe and America | 59,036 | 62,533 | 5,870 | 33,586 |
| Metallic Content from Bolivia to Europe..... | 21,149 | 24,843 | 1,670 | 12,264 |



❖ REVIEW OF MINING ❖

INTRODUCTORY.—After a long period of depressing financial weather, varied by cyclonic thunder-storms, we see a glimpse of blue sky. It is not much larger than a man's hand, but as it is accompanied by a rise in the barometer, in the shape of an increased supply of money, we are hopeful. The French and Indian loans were over-subscribed handsomely. The Carsonistas in Ulster and the Carancistas in Mexico are uncompromisingly belligerent, but everybody, even themselves, is weary of the wrangle. Some settlement is sure. The crops in America are unusually plentiful. A re-adjustment of railway rates is imminent. The Near East is too exhausted for another war. The tin, copper, and lead markets are ready to rise. Zinc is under control. News from the mines, on the whole, is cheerful. The Rand is again optimistic; new producers are making Rhodesia look expansive; the drought on the Indian goldfield is broken. A further expansion in Siberia is imminent. All that is needed now to restore animation in the financial and professional departments of the mining industry is the re-opening of Mexico to business.

TRANSVAAL.—The output of gold in June, allowing for the 30-day month, is good. As regards the labour statistics, the increase of 815 compares with a decrease of 9550 in June last year, that being the time of the big strike, which culminated in the outbreak of July 5. Fortunately the anniversary of that event has passed quietly. Normally a decrease of about 5000 natives would be expected in June, owing to the seasonal migration. Hence the June

figures are excellent. However, the number now employed is still 22,000 less than a year ago.

A summary of the dividends declared on account of the first half of this year's operations on the Rand shows that the total is £4,053,349 as against £3,922,711 and £4,183,606 in the two preceding half-years. The result is largely affected by the 19%, or £330,000, distributed by the Robinson, the bonus of 10% representing a beginning of the process of liquidation. The most notable increases are those of the City Deep (from $7\frac{1}{2}$ to $11\frac{1}{2}$ %), Langlaagte Estate (from $2\frac{1}{2}$ to 5%), Van Ryn Deep (from $7\frac{1}{2}$ to $12\frac{1}{2}$ %), and Village Deep (from 5 to 10%). On the whole, having regard to labour troubles, the showing is good.

Decreases in cost are a cheerful item in Rand reports. The New Goch made a new record in June with a 'working cost' of 14s. 2d. per ton, and the New Modderfontein, which is doing excellently, came down to 15s. 1d. per ton. These figures do not represent the total cost, which, however, is reduced proportionately.

Sir George Albu struck an optimistic note at the General Mining & Finance Corporation's meeting. The probability of obtaining an adequate supply of labour seems good to him, but to us, at a distance, the return of normal wet seasons seems likely to accentuate the deficiency by lessening the natives' need to work in the mines.

The West Rand Consolidated issues an excellent map to illustrate Sir George Albu's clear description of recent developments. It



THE ABBONTIAKOON MINE

is remarkable how much exploratory work has been done "off the reef." Apparently the assistance of a mining geologist might have obviated this expensive divergence. However, the Main Reef proper has now been found in a bore-hole from the 8th level, so that further aberrancies may be avoided.

The mill on the Government Gold Mining Areas is to be completed in October. This will make a notable addition to the productive mines.

The 7 mines of the Far-Eastern Rand contributed 13% of the total ore crushed, and 20% of the total nominal profit earned, on the whole Rand in May.

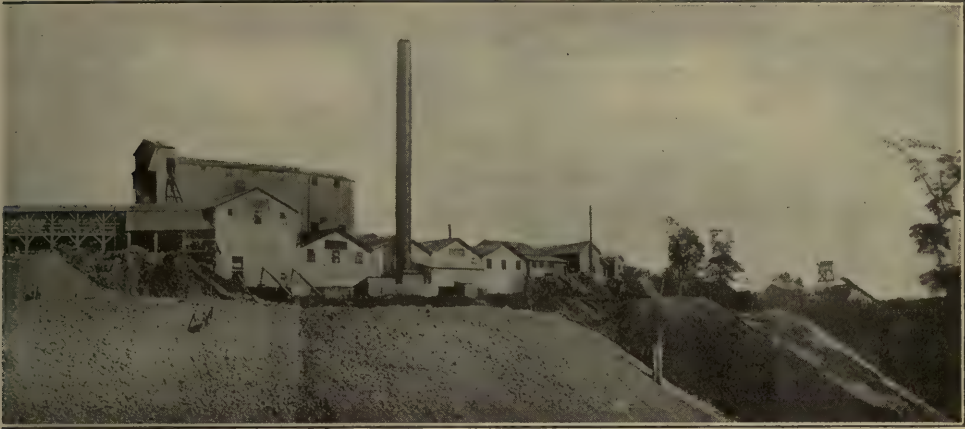
The Luipaard's Vlei mine, on the Far West Rand, has regained the dividend stage. We congratulate the management. By the addition of two tube-mills, the tonnage treated monthly has been increased to 21,000 tons. Meanwhile, the exploratory work in the old workings of the Windsor section has proved successful. After unwatering, a winze sunk below the 240-ft. level has found 3 feet of $11\frac{1}{2}$ dwt. ore. By the way, a shaft is *unwatered*; a pulp is *dewatered*.

The old Lisbon-Berlyn mine, owned by the New Lisbon-Berlyn, Limited, is again about to become productive. A reserve of 90,000 tons of pyritic gold ore, yielding 34s. per ton,

is estimated. In the new mill this ore will be crushed to 30-mesh by rolls and ball-mill; then it will undergo roasting, previous to leaching of the copper in a weak sulphuric acid solution, after which the pulp will pass over Callow screens, while the over-size is tube-milled and returned over the screens. The remainder of the treatment is according to standard practice. A 5-ton test showed excellent recoveries: 94% of the gold, 92% of the copper, and 68% of the silver. This mine is among the oldest in South Africa, and holds the record for reconstructions.

WEST AFRICA.—The May statistics exhibit a further increase in the amount of gold produced, which, at £145,227, is the largest output since April of last year. However, a decrease of £59,850 is shown by the total of the first five months as compared with the same period in 1913.

The Abbontiakoon has paid its first dividend and promises to pay many others. We like the manner in which detailed items of cost are given, and the way in which the whole cost is frankly stated. On an output of 108,500 tons, yielding 43s. 5'2d. per ton, the total cost last year was 29s. 1'92d. per ton, exclusive of interest on loan, but including London expenditure, depreciation, and development redemption. Since January the cost has been



IN WEST AFRICA.

reduced 1s. 5d. per ton, while the tonnage in reserve has risen (at March 31) to 661,531, averaging 9'82 dwt. per ton. The loan indebtedness has been decreased from £140,000 at the end of 1912 to £35,000 at the present time.

License to prospect for gold has been granted to the Champion Tin Fields and associated companies in Nigeria. The area in question is said to be traversed for 32 miles by a river that has been proved to be gold-bearing for its entire length. No data are given; even the locality is not specified. It is interesting, but of no economic importance, as yet.

It looks as if the Niger Company intended to separate its mining from its trading activities, taking steps at the same time to gain control of the technical operations of its subsidiary mining enterprises. This applies to the Forum River, Ninghi, Zuma, Lafon River, and the Bisichi. The first four of these were sold by the Niger Company, and floated by the Northern Nigeria Trust, on reports of a highly optimistic character, followed by inflated capitalizations, the burden of which is now being felt. The Bisichi is the most promising, but it also is none too healthy.

The Benue dredge, having been relieved of the Diesel oil-engine in favour of the conven-

tional steam-engine, will, it is hoped, resume digging some time in the autumn. When the ready-made dredge was bought by the company, the cutting of firewood was prohibited, hence the idea of using oil; later when the use of oil had proved unsatisfactory, the Government withdrew the prohibition, whereupon it was discovered that wood was cheaper than oil by £14 per ton of tin concentrate. According to the chairman, Mr. C. E. Pearson, the "big lode" in the Gingia area joins the number of "exploded" expectations. Our sympathy goes to the new manager, Mr. J. B. Settie, who has to work in the wake of several 'explosions.'

The railway is now open to Jos, and will assist several mines, notably the Rayfield, which is now only 4, instead of 45, miles from rail. Incidentally, we note that the Jos dredge is getting into its stride, treating 20,000 cubic yards in June for a yield of 40 tons of cassiterite, equal to 4½ lb. per yard.

The Ropp, with a capital of £30,000 might do well, if that capital did not have to be so largely increased for dams, ditches, plant, and equipment. The Naraguta is undoubtedly the best property on the plateau.

At the Naraguta Extended everything is ready for an active season, now that a supply of water is available. Five 14-inch pipe-lines

have been laid for distances varying from 400 to 1200 yards. These will operate sixteen 2-inch nozzles under a pressure varying from 50 to 77 ft. The average depth of tin-bearing gravel is about 14 ft., estimated to contain 3 lb. cassiterite per cubic yard. Of such material 1,000,000 yards is said to be proved. The cost by hand was 4s. 6d. per cubic yard; by ground-sluicing it was 2s. per yard last year; by hydraulicking it should be done for 1s. 9d. per yard, including amortization of the expenditure incurred on account of plant. An output of 600 tons is expected, but this will depend upon the skilful use of the water available during the six months ending in October. Information is lacking, especially in regard to the financial position of the company. Mr. A. H. Watson is manager, in succession to Mr. Jerome J. Collins, who expressed the opinion that the outlay for plant and equipment was not justified by the extent of ground that had been proved.

RHODESIA.—The output of gold in May was 68,983 ounces, worth £290,062; this being a slight decrease as compared with April. The Cam & Motor contributed £13,958 from 11,120 tons, while the Shamva yielded £22,487 from 46,730 tons, so that the averages were 25s. 1d. and 8s. 6d. respectively. However, the Shamva return is abnormal, owing to absorption of gold in the plant. In April the yield was 14s. per ton.

Metallurgical difficulties at the Cam & Motor are being overcome, but with inevitable slowness. In June the extraction rose to 63% on an ore assaying 46s. per ton.

The Shamva returns for May were affected adversely by the substitution of further leaching plant in place of the amalgamating plates. The removal of the latter is expected to reduce the cost of milling and to lessen the risk of theft, the amalgam being so conveniently detachable. In consequence of the addition to the leaching plant, a further absorption of gold ensued, reducing the amount recovered

by 28%. A normal clean-up is expected for June. This should furnish a good guide as to the prospects of the enterprise. The estimated extraction is high, namely, a loss in residue of only 6 grains out of ore averaging 3 dwt. 10 gr. per ton, indicating a metallurgical extraction of 92.7%.

AUSTRALASIA.—At the Zinc Corporation's meeting, Mr. F. A. Govett, the chairman, made befitting acknowledgment of the technical skill to which the enterprise owes its prosperous condition. To Messrs. George C. Klug and C. G. Hylton of the staff, and to Messrs. E. J. Horwood and F. J. Lyster of the improved processes, he gave credit. We feel sure that the members of the staff in turn would be the first to recognize the financial skill and wakeful sagacity of Messrs. Govett and Hoover. Therefore, it remained only for the shareholders to thank both departments of the administration, which was done in excellent form. Naturally, the Zinc Corporation's profit rises and falls with the market price of the two metals involved, lead and zinc; the exact ratio was made clear by the chairman and by Mr. H. C. Hoover, according to whom a combined metal price of £39 is equal to a profit of 2s. per share. Similarly direct information was given concerning the amount of ore developed by the successive levels; this presents unusually satisfactory features, being now at the rate of 450,000 tons per 100 feet of vertical development. Between them, the two leading spirits of the Zinc Corporation gave the meeting a remarkably clear-cut statement of its prospects.

The Bullfinch Proprietary has proved as disappointing as we anticipated. In January 1913 a yield of 60s. per ton and a working cost of less than 20s. per ton were estimated officially. The cost last year was 25s. 8d. per ton, while the yield in gold was 54s. 7d. per ton, but even this result was not obtained without selecting the richer part of the orebody, for the reserve at the end of 1913 is given as

145,582 tons of ore averaging 36s. per ton. We commend the manager's advice to postpone shaft-sinking pending further lateral exploration.

The whole of the new plant at Mount Morgan is not yet in operation, hence the small tonnage treated. It is said that boring operations on the bottom level have proved disappointing, indicating that the separation between smelting and concentrating ore in the mine will not be effected so easily as expected.

UNITED STATES.—Good news comes from Treadwell, where \$3½ ore has been cut on the 2100-ft. level of the Alaska United's 700-ft. claim. This is one pennyweight of gold higher than the average of the ore in reserve, as against a total cost of less than \$1.50 per ton. The new central shaft has been sunk with a view to a comprehensive deeper development of the Treadwell group of mines, as described in our issue of January under 'Successful Mining.' During 1913 the three companies did not do so well, being in what is recognized as a poor zone, but it would now appear that Mr. F. W. Bradley's expectations are going to be realized. We hope so. No mines are better managed or more worthily exemplify legitimate industry.

CANADA.—Electric power became available at Kirkland Lake early in June. The power-plant at Charlton is controlled by Mr. K. Farah and the line of transmission is 26 miles in length. Some of the handsomest specimens from the Tough-Oakes went down in the *Empress of Ireland* with Sir Henry Seton-Karr, who was returning to England from the mine. Diamond-drilling has been started on adjacent properties, notably the Hunton claims.

Mr. D'Arcy Weatherbe's report to the Mining Corporation of Canada, concerning the general factors governing operations in the constituent properties, has been issued. He touches upon the local geological conditions, which are unusual, and explains the difficulty

of estimating reserves in veins so small, rich, and irregular. Having regard to his obvious caution, the report may be considered favourable. Only in the case of the Cobalt Lake mine does he take serious exception to the published estimate, while at the same time acknowledging the possibilities of further important discoveries in this ground. Incidentally, he corrects an error made by *The Statist*, which criticized the milling of ore yielding less silver than the amount required to meet the average expenditure. This, of course, is due to the fact that, when mining streaks of rich ore, it is necessary to break a large width of low-grade stuff, which it is more profitable to treat in the mill than to use as stope-filling.

RUSSIA.—The report of the Russian Mining Corporation was eagerly awaited and has been well received. No profit, of course, is shown, for the year's operations were confined to the incubation of new business, of a most promising character. The approval by the Zemstvo of the contract for the supply of water and drainage to the suburbs of St. Petersburg marks an important success, for this is likely to lead to further business of a similar character, to be undertaken by the Corporation. The option on a half-interest in the Vagliano anthracite colliery is in abeyance pending the settlement of legal troubles in which the vendor company is involved. The chief interest, of course, of the Corporation is the Thurn & Taxis concession in the Altai; this embraces an area of 14,000 square miles, and includes a number of old mines, two of which, the Zeranovsk and Zminogorsk, have a promising record of productivity. Mr. J. Power Hutchins, assisted by Mr. E. D. McDermott, has reported favourably on the prospects. A geological investigation is in course of being made by Mr. H. W. Turner. Four diamond drills have been ordered, and the two principal workings are being unwatered. Mr. A. von Gernet will act as consulting engineer in connection with this enterprise in the Altai;

he knows the region well, and has already aided the corporation in its negotiations. Mr. Hutchins will be general manager, with headquarters in London.

Developments at the Atbasar continue satisfactory. On the lowest or 630-ft. level, the cross-cut went through 25 feet of $12\frac{1}{2}\%$ copper ore, while the west drift for 115 feet has been in 18% ore for its full width of 10 feet, and the east drift for 65 feet has averaged 9%. The present reserve of first-class ore is 50,000 tons assaying over 20%, together with 360,000 tons of concentrating ore containing 7% copper.

Further expansion of the Siberian mining industry is indicated by the erection of a lead smelter, by Aron Hirsch & Co., at Riga, to treat ore to be shipped, through the Suez Canal, from the Amur, where an important deposit of silver-lead ore (lead 24%, silver 15 oz. per ton) has been opened-up on a large scale. More is likely to be heard of this enterprise in the near future.

MEXICO.—An agreement has been made between the American and British governments, whereby each undertakes to discountenance the efforts of their respective nationals unfairly to acquire each other's mining property during the current disorder.

The elections on July 5 were a pitiful farce, the number of votes recorded being insufficient even to give a semblance of reality to the re-election of Huerta.

The rebel, or Constitutionalist, forces have captured Aguas Calientes, and are therefore 75 miles south-east of Zacatecas. Meanwhile, the mediators at Niagara have taken a recess, with the declaration that "a peaceable outcome is assured." We shall see. Events are moving to a new crisis, for the insurgents will reach Mexico City shortly. As matters stand the most probable is the unexpected.

It is announced that the American Smelting & Refining Company has given orders for a general resumption of work at its mines and

smelters in Mexico. This indicates the relative pacification of the northern States.

On July 6, the Santa Gertrudis mill resumed crushing on dump material, it being deemed inadvisable under existing conditions to produce more bullion than is needed to meet current expenditure.

INDIA.—The drought in Central India has been broken and the full flow of water has been restored at the Cauvery Falls hydro-electric station. The Kolar gold mines are now obtaining their regular supply of electric power. During the two months of shortage, the old steam installations were used as far as possible, with the result that the hoisting and milling plants were kept going. Development, however, was almost entirely suspended.

Eighteen months ago exploration of the ground south of the Mysore boundary was commenced on the 2160 and 2385-ft. levels. The Mysore Company undertook to spend £5000, and the Mysore Southern Extension Syndicate was formed as a subsidiary to conduct the work. Mr. Arthur Gifford reports that the results have been unsatisfactory, for the ore-shoots exposed have been erratic in width and content. Further testing is to be done before the work is abandoned.

CORNWALL.—We publish this month an analytical criticism of present conditions in Cornwall, written by Mr. D. Gill-Jenkins, an engineer thoroughly acquainted with his subject. Even those who do not agree with his conclusions will recognize the value of the statistical information presented.

The patience of the directors and shareholders of the Levant company is being severely tried by the indifference shown by the lords with regard to the renewal of the leases. The difficulties of the adventurers is increased by the fact that the property comes within the boundaries of five separate mineral estates. Any attempt to arrange a personal meeting between the board and the lords is rendered abortive either by the forgetfulness of the

lords or by the exigencies of old-fashioned legal routine. We fear that Mr. Francis Oats and his friends will have no alternative but to cease operations at the end of the current lease, this time next year. Owing to the low price of tin, losses have been made recently, and in view of the probable stoppage, the directors have decided to reduce the scale of working, and to mine only the richer ore. Fifty men have been dismissed, and another fifty are to go at the end of this month. At the Hobb's Hill open-cut, north of Bodmin, Mr. David Draper expects to start his Nissen stamps and James tables next month.

Three mines will shortly be added to the list of producers. At the Garlidna, near Wendron, 4 Nissen stamps and 6 James tables have been started. At the Tresavean, near Redruth, 8 Nissens and 16 Buss tables are to work, but as the furnace for roasting the first concentrate is not complete, a final concentrate will not be produced for a few months.

VARIOUS.—The Pato dredge, after two bad months, has resumed good returns. The course of the dredge was continued through the tested area and cut into ground containing so much clay as to hinder the gold-saving. Then came the dry season and a lack of water. Now the dredge has been turned and is advancing into the ground that proved so productive during the latter part of last year. High yields may be anticipated. In order to provide water during the dry season, a large pumping plant, at a cost of £6000, is to be added.

The favourable report of Mr. Thomas Richards gives good reason for believing that the Ouro Preto will justify the expectations of the management, despite the sudden drop in the grade of the ore during the past year. Mr. Arthur J. Bensusan, the resident superintendent, is able to speak cheerfully concerning the deepest development, a new orebody having been uncovered in the southeastern end of the Passagem workings. He joins with Mr. Richards in advocating an increase

of output from 7000 to 10,000 tons per month, so as to reduce the cost to 21s. per ton, on a yield of about 26s. per ton. To raise the necessary capital it has been decided to issue preference shares.

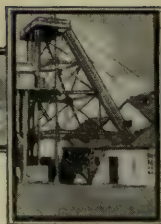
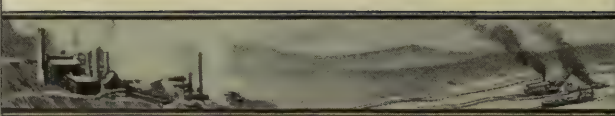
Rio Tinto has experienced another of its periodic labour troubles. In the middle of June the passive resistance of 2000 men on strike rendered work impossible, whereupon the company decided to suspend operations and close the mine. When this became known, the strikers resumed work.

The acquisition of a substantial interest in the Cordoba Copper company by the Central Mining corporation is marked by the nomination of Mr. H. F. Marriott to the board.

News from the Bawdwin mines of the Burma Corporation is most favourable. The new internal shaft, being sunk from the Chinaman adit, is down 75 feet in excellent ore. The south drift on the Shan lode at the 430-ft. level is exposing a width of 30 to 40 feet of ore, averaging 29 oz. silver, 32% lead, and 22% zinc. The Chinaman orebody has now been proved for a length of 1277 feet, for an average width of 12½ feet, assaying 15 oz. silver, 17½% lead, and 13% zinc.

The circular announcing the Exploration Company's removal to No. 24 Lombard Street, refers also to the favourable report made by Mr. R. M. Raymond on the Chuquicamata mine in Chile. At the last annual meeting, Mr. R. T. Bayliss mentioned the fact that the Exploration Company had acquired an interest in a property, which, as far as we can ascertain, is the biggest copper enterprise extant.

The Rio del Oro Co., controlling the El Amparo mine in Venezuela, is among those issuing information that is not informing. The tons treated, ounces of gold extracted, and approximate value are stated periodically, but these data, in default of any statement of cost, are of no use to the shareholders, one of whom complains to us that he is kept in the dark.



EDITORIAL



PORTSMOUTH is the place of meeting for the autumn conference of the Institute of Metals, on September 10, under the presidency of Sir Henry J. Oram.

THIS issue marks the beginning of our 11th volume, each volume covering a half-year, save the first, which included four numbers only. We are still young, and hopeful.

ONE of the Nigerian companies charges the digging of elevator sumps, and the moving of an elevator from one place to another, to capital account. Clearly notions of 'cost' in mining vary as the sagacity of those using them.

AMONG the Birthday Honours we note the knighthoods bestowed upon Mr. Richard A. S. Redmayne, Inspector of Mines, and Mr. Thomas Kirke Rose, A.R.S.M., Chemist to the Mint. In both cases the bestowal of honour will gratify not only the immediate friends of the recipients but the larger public that loves to see true merit officially acknowledged.

BOTH our Toronto and San Francisco correspondents have something timely to say regarding the Calgary oil-field, now the scene of excited speculation. Mr. Reginald Brock, the Deputy Minister of Mines, and lately Director of the Canadian Geological Survey, has issued a warning against inflated expectations.

STEVENSON, in one of the letters recently published, wrote concerning correspondents that sent him stamps from their

own post-office, instead of stamps usable at his post-office. This is often our experience. More curious is the fact that many letters sent to us from America bear a 5-cent stamp, despite the fact that penny postage across the Atlantic is now well established.

THE DECISION of the Union Government to drop the proposed land tax has been received with satisfaction by many shareholders. It was a fresh impost on British capital and would have been an unpleasant burden on numerous mining-land companies. Mr. F. J. Dormer has been prominent in his opposition to the tax, and to him credit is due in this matter.

AT the annual meeting of the Mining and Metallurgical Club, on June 30, Mr. Edgar Rickard was elected president, in succession to Mr. Vere Herbert Smith. The five retiring members of the committee are succeeded by Messrs. Richard C. Griffith, Ernst Lichtenberg, Frank Merricks, Edward T. McCarthy, and C. R. Pinder. We are glad to note that the idea of rotation, as regards the composition of the general committee, has become established.

SHAREHOLDERS rarely find trustworthy defenders. Mr. Aubrey Hyman, after a victorious tilt against one of the so-called big houses, offered himself as a candidate for a seat on the board of the Robinson company. To win support, he promised to distribute a bonus twice as large as that indicated by the present board, ignoring the fact that such a distribution would involve drastic

liquidation on a depressed market. Many people are smart; not many are wise.

WE NOTE that the circular of the Sixth International Congress of Mining, Metallurgy, Engineering, and Economic Geology, which meets in London next year, contains no mention of the Institution of Civil Engineers, although the names of 14 different technical authorities and institutions are included among those participating in this important convention. Either the Institution of Civil Engineers is detached from the mining and metallurgical industries, or it is lacking in public spirit; in any case its assumption of authority in mining engineering is humorous.

CHANGES OF ADDRESS are not always significant, but the removal of the offices of the Exploration Company from No. 11 Cornhill to No. 24 Lombard Street will interest many of the older generation. Time was when No. 11 Cornhill was a notable incubator of mining business, especially in Western America. The Exploration Company has lost its eminence since the mining industry of the Rand evolved the bigger financial houses in London, and the smelting business laid the foundations of Guggenheim enterprise in New York, but it is still an important factor, especially in Mexico. We hope that the change of quarters will coincide with renewed prosperity.

THE DIRECTOR of the Rhodesian Geological Survey, remarking on a decrease in the sale of prospecting licenses, and the apparent decline in prospecting, recommends the employment of qualified prospectors, under the supervision of mining engineers. Also he expects this to be done by other than "private enterprise," although it is not clear whether the Government, the Chartered Company, or the financial houses are to become sponsors for the necessary ex-

penditure.—With both these premises and conclusions the editor of the *Rhodesian Mining Review* takes issue. We tender him our hearty concurrence. Prospectors and prospecting, like genius, is based on one part of inspiration and nine parts of perspiration. All that the authorities can do is take care that their regulations are more of an enabling than a disabling character. For the rest, the *sacra fames auri* will provide an adequate stimulant.

BUTTE has come into unpleasant prominence by reason of an affray between labour agitators. The daily newspapers of London united in explaining to their readers that "Butte is the largest mining camp in America," and that is all they had to say. The principal town of Montana has long passed that temporary stage of settlement properly called a 'camp,' for it has a population of 40,000 and is built substantially. If the term 'camp' is to be applied, it must be in a military sense, as the headquarters of belligerent people. The prestige of Butte as the centre of a great copper industry has been obscured repeatedly by riot and disorder arising from labour quarrels. Butte has long been the focus of the form of labour activity that cultivates the poisonous flower of anarchy.

WITH 600,000 shares at £2½, the Shamva has to pay on a valuation of £1,350,000. Accepting official estimates, an actual distribution of £200,000 per annum would be equivalent to 14·8%, which is not enough to redeem the capital, having regard to the short life of the mine. The reserve of 2,500,000 tons will last for about 4 years on a crushing capacity of 50,000 tons per month. As prospects of any large addition to the ore reserve are slender, it is fair to assume that the mine will not be at maximum production for more than 5 years, yielding about £1,000,000. If the investor takes 7% as income, and re-invests

the remainder of his dividend at 4%, the present value would be about 27 shillings per share.

IN an address given on the occasion of the Columbia School of Mines 50th anniversary, Mr. Hennen Jennings drew some interesting lessons from a review of modern mining. We are indebted to the *Mining and Scientific Press* for the text of this admirable essay, in the course of which the distinguished Harvard graduate and Rand engineer proved again that statistics have an eloquence of their own. It is an astounding fact that the metal production of the United States is now five times what it was 32 years ago, while the non-metal mineral output has increased eight-fold. In the last 12 years the production of iron, copper, and gold has been equal to that of the preceding 100 years. The coal and petroleum output of one year now yields the physical energy of 2,700,000,000 strong men. While the output of gold has increased, the superstructure of credit has augmented even more rapidly as civilization has extended over the globe. The growth of mining education has been roughly proportioned to the commercial demand for technical knowledge, the number of students enrolled in the mining schools of the United States being proportioned to the number of men engaged in mining. This, of course, is not true of the British Empire, which does not maintain even one school of mines on an adequate scale of endowment, but appears to prefer dependence upon the product of the American and German schools of mines. Such are some of the ideas with which Mr. Jennings' address is highly charged. It ends on a high note, insisting on the value of character-building as a preparation for the intensely technical and necessarily hazardous business of mining. We refer our readers to the full text of the address, which, in its comprehensive character, it is difficult to summarize.

RE-ORGANIZATION has followed in the wake of the Grenfell collapse. Fortunately the three principal mining companies involved, namely, the Camp Bird, Santa Gertrudis, and Messina, are all genuine enterprises with sufficient vitality to withstand a financial shock. The resignations of the Grenfell brothers and of Mr. J. S. P. Samborne have made room for several notable additions to the various directorates. In each case Mr. H. C. Hoover is the principal new factor. On the Messina he is accompanied by Mr. C. F. H. Leslie; on the Camp Bird and Santa Gertrudis he will be associated with Messrs. F. A. Govett and F. H. Hamilton. We congratulate the shareholders on the change, which is all to their gain. In Messrs. Hoover, Hamilton, and Govett the companies will have the services of three men of unusual experience and sagacity. As regards the former members of the Camp Bird and Santa Gertrudis boards, it is only just to say that Mr. F. W. Baker comes out of the ordeal with a distinct gain to his reputation. As far as we know—and we are well informed in this matter—he saved both companies from a big loss by prompt action as soon as he detected signs of things going wrong. On the whole, we conclude that shareholders in these three companies have been fortunate in escaping disaster, and in finding exceptional men to come to their assistance at a critical juncture.

ELSEWHERE we give an account of the Chuquicamata enterprise. It may interest our readers to know that Duncan, Fox & Co., of 29 Great St. Helens, controlled the Compania de Cobre de Chuquicamata, which owned the principal group of claims, while Mr. William Lyon of Valparaiso controlled the Cicilia group, which with the other group constituted the main portion of the Chuquicamata property. The credit for initiating the enterprise belongs, we believe, to Mr.

Claude Vautin, who became interested in it as early as 1906. Through his negotiations with Mr. A. C. Burrage, over the Ferrobamba property, in Peru, he became acquainted with that financier, and brought the Chuquicamata to his notice, much to the latter's enrichment, for he obtained 1,000,000 shares, while the Guggenheims received 3,000,000 shares, of a par value of \$25 each. Undoubtedly the detection of the fact that the chief copper mineral was not atacamite, but brochantite, was the key to the technical success now to be achieved on a scale so imposing.

THAT grand old mine, the St. John del Rey, in Brazil, is still hale and hearty, although the workings have reached Horizon 17, equivalent to a vertical depth of 5200 feet. The size and gold contents of this unique ore-body remain satisfactory. An effort to increase the supply of labour by importing Japanese has proved a failure, for, out of 107, not one remained for the whole year. However, financial conditions in Brazil are favourable just now to an increase in the local supply of labour, which, at present, is adequate for the mine. The deepest metal mine in the world is the Tamarack, for the No. 5 shaft was sunk to 5368 feet. According to the plans sanctioned by the St. John del Rey company, a new record for deep metal mining will be made before the close of the current year.

DISCOVERIES of pitchblende are reported in the Gaya district of the Bihar province of India. This pitchblende is found in a pegmatite dike, traversing muscovite schist, according to a report by Mr. R. C. Burton, of the Geological Survey. Operations are being conducted by Mr. H. E. Tiery, of Calcutta. Uranium ochre was first seen as a discoloration of the outcrop; since then nodules of pitchblende have been found in several shallow pits. The largest nodule

weighed 52 pounds. The mineral association includes mica, triplite, ilmenite, tourmaline, columbite, zircon, and torbernite. Most of the nodules are surrounded by uranium ochre. It is asserted that the pitchblende is highly radio-active. We trust that this interesting and valuable discovery will not become the sport of joint-stock finance, for which such erratic ore deposits are quite unsuited.

LIQUIDATION of a mining company is rarely delayed by so graceful an episode as that which marked the last hours of the Montana Mining Co., Ltd., the owner of the once famous Drumlummon mine. Before appointing a liquidator, it was voted to pay a substantial sum to Mr. C. J. Cooke, the secretary, who has been honourably connected with the company for 27 years. The enterprise was started in 1883 on a capital of £600,000, returning a total of £630,000 in dividends to the end of 1899, since when operations have been unprofitable. Its early history is associated with the names of John Darlington and Thomas Bewick. Mr. R. T. Bayliss was at one time resident manager and then consulting engineer. As was said at the finish, this company has a clean record; it has been well served by able men; and if it fell on evil days, owing to litigation and final impoverishment of the mine, it has contributed an honourable page to the story of mining.

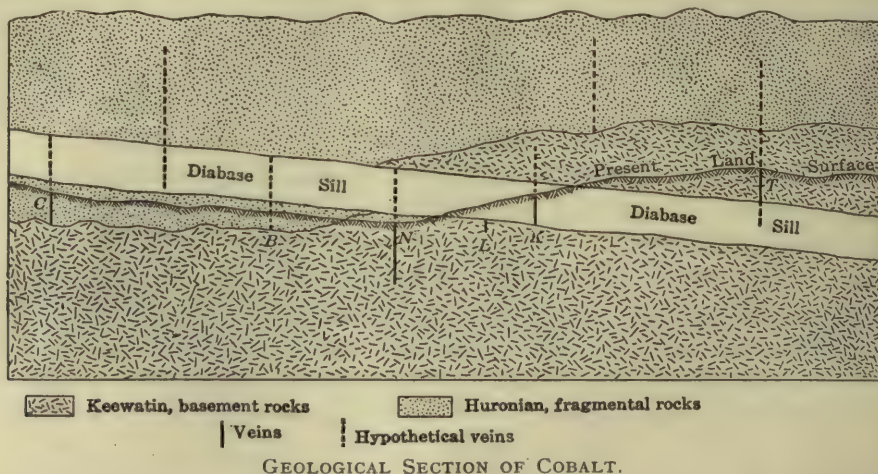
PARLIAMENTARY discussion of the Admiralty's deal in Persian oil-lands, in opposition to the Shell Transport and Spies Petroleum companies, draws attention to the fictitious price of petrol. In England it is sold to motorists for 1s. 8d. per Imperial gallon, while in New York the price is only 20 cents per American gallon, equivalent to 12 pence per Imperial gallon, as against a wholesale price in America of 12 cents or 7½ pence, according to the two different measures. Some relief seems likely, for it is an interesting fact

that in April the steamer *Barneson* was chartered at San Francisco by the English company controlling the General Petroleum and Union Oil companies in California; to bring 3,250,000 gallons of distillate to be marketed here as 'petrol' or mixed with spirit of lower gravity. The price of distillate at San Francisco is $5\frac{1}{2}$ cents per American gallon, the freight to England is 6 cents round the Horn and will be $3\frac{1}{2}$ cents through the Panama Canal, so that it can be landed next year for $5\frac{1}{2}$ d. per Imperial gallon. The fancy price of petrol is due to three causes: the near monopoly, middlemen's extortions, the Government tax, and the restrictions neces-

sary to safeguard a product so inflammable. This was foreshadowed several months ago. It indicates that the so-called exploration company is to be used for inter-company dealings, such as those of which we have seen more than enough in Rhodesia. The use made of an interview with the Premier of Quebec recalls the Bullfinch episode and the West Australian Premier's *betise* in contributing to a boom by expressing an opinion that had no technical value.

Cobalt.

No better example of the application of geology to mining could be furnished than the



sary to safeguard a product so inflammable. All of these, in time, will be modified. The shipment above mentioned is a sign of the times. It is full of promise.

EFFORTS are being made to push the Kirkland Lakeshares, notably the Tough-Oakes. While the developments in that mine are most satisfactory in proving the richness of a number of small veins, it is obvious that the future of the property has been fully discounted as work has progressed. The other companies are 'pups' nourished on the prominence of the principal mine of the district. Mr. H. G. Latilla, it is announced, has joined

the board of the Kirkland Lake Exploration. This was foreshadowed several months ago. It indicates that the so-called exploration company is to be used for inter-company dealings, such as those of which we have seen more than enough in Rhodesia. The use made of an interview with the Premier of Quebec recalls the Bullfinch episode and the West Australian Premier's *betise* in contributing to a boom by expressing an opinion that had no technical value.

story of the Cobalt district, which was explored in the light of the prompt geological diagnosis of Mr. Willet G. Miller, the Provincial Geologist to Ontario. Interest in the subject is awakened by the recent report of Mr. D'Arcy Weatherbe on the work being done at the Casey Cobalt mine. This locality is twenty miles north-east of the town, but constitutes an integral part of the mining district from which the world now derives about 14% of its silver supply. At Casey, the three terrains characterizing the local geology are exposed on the surface, namely, the schist, conglomerate, and diabase. The basement rock is the schist, called the Keewatin. On this

lie the conglomerate, slate, and altered quartzite of the Huronian. Both these pre-Cambrian formations are penetrated by the Nipissing diabase, in the form of an intrusive sheet or sill. Natural erosion has left only remnants of the diabase and conglomerate where they lie upon the schist. Although the diabase penetrates the Huronian, no conglomerate has, as yet, been found overlying it, but this condition is likely to be disclosed eastward. We give herewith the ideal section drawn by Mr. Miller in 1905. It exemplifies the constructive imagination of the scientific man as applied to the advantage of industry. While a great deal of information has been obtained in the course of mining development in the Cobalt area, it is only fair to say that this original diagnosis of the Provincial Geologist has remained the chief guide to exploration. Theories of origin have been various, but the main structural features, as determined by Mr. Miller, have become thoroughly established. And this we say with cordial emphasis, because sundry later writers on Cobalt have appeared to overlook the fact, or to treat it as if it were negligible. On the contrary, we hold that a mining district is served most by the first correct explication, and that no geological post-mortem can compare in value with the diagnosis made in its early youth. In saying this, we shall have the warm agreement of the engineers actually engaged in steering the advance of the miner underground. For instance, Mr. Weatherbe, in ascertaining the structure of the particular claims owned by his company, will be the first to acknowledge the value of the sections already published by the Bureau of Mines. As regards the Casey property, his recent drilling has demonstrated a relation highly favourable to the finding of ore. In the Cobalt district generally the ore-shoots in the veins appear to be genetically connected with the contacts between the various formations in the vicinity of the diabase. In the Casey property the ore-shoots found

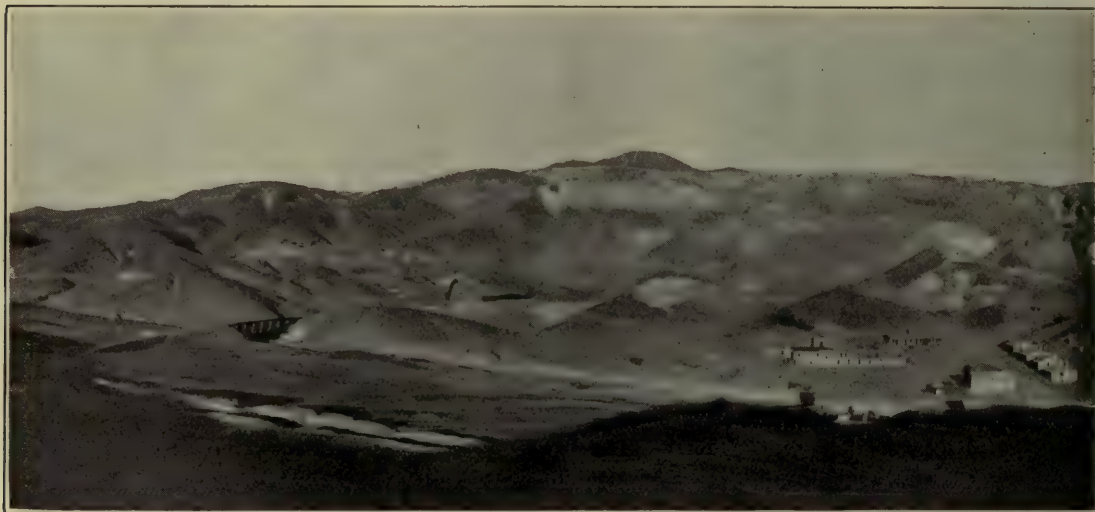
in the conglomerate appear to extend from the contact with the schist to an upper limit that runs roughly parallel with that contact, even though the veins themselves reach higher. This is in accord with conditions noted in the celebrated Coniagas mine. Moreover, a bore-hole in the eastern end of the Casey property, where the conglomerate forms a wedge between the underlying schist and the overlying diabase, has penetrated country containing enough native silver to invite confident exploration. Here, according to local experience, is a promising locality, for the two contacts are so near each other as to intensify their favourable influence. This influence arises from the fact that the hydrothermal solutions, to which the ore deposits owe their origin, were a sequel to the igneous intrusion of the diabase and followed the fissures made near the planes of contact. These contacts with the diabase were lines of fracture, due partly to the cooling and contraction of the sill, and partly to the dislocation associated with that igneous intrusion. Thus, by observation and reasoning therefrom, the geologist can suggest the most likely place to find ore; he can also indicate the places least likely for such concentrations of valuable mineral; but he cannot assert confidently that at any given place ore will be found. In short, he limits the search and thereby decreases the cost of exploration. He saves the miner from useless labour, and guides him to the places where he may reasonably hope to work profitably. After all, as Mr. R. A. F. Penrose has pointed out, an orebody is an exceptional enrichment. Like the pearl in the oyster, it is an abnormal segregation, due to unusual conditions. The aim of the geologist is to ascertain where such unusual conditions exist, and to explain them afterward. The miner is more grateful for the direction than the explanation, as the wayfarer prefers being told the right road than being informed how or by whom it was built. At Cobalt the miner early found a scout by

the roadside and thus saved himself many wasteful divagations.

Chuquicamata.

This name is likely to become famous in the records of mining, for it has been stated already on good authority that the tonnage of ore assured is twice as large as that in the Rio Tinto, long quotable as the biggest copper mine in the world. Taking the ore reserve

chantite, together with atacamite, chalcantite, and other oxidized minerals of copper. The lode has been tested by bores, which prove the ore-bearing ground to be 200 to 1000 yards wide for a length of $1\frac{1}{2}$ miles. In depth the drill-cores show chalcocite, and then chalcopyrite, with pyrite; although in places the sulphides extend even to the surface. It is a mineralized zone in granite, exploited hitherto for its thin stringers of rich ore, but to be work-



THE CHUQUICAMATA MINE

of the Rio Tinto at 100,000,000 tons, averaging 24% copper, we can contrast it with 211,000,000 tons, averaging 2'18% in the Chuquicamata, as proved by churn-drilling down to 1100 feet vertically. This remarkable ore deposit is situated in the desert highlands of Chile, at an altitude of 9500 feet and a distance of 85 miles direct from Antofagasta, which is reached by a railway 165 miles long. The deposit has been worked on a small scale to a depth of 75 feet only, by sundry parties during the last twenty years, and has already yielded fully 1,000,000 tons of ore from a network of shallow diggings, extending for a width of 200 yards and a length of one mile. These disclose a belt or sheer-zone in granite enriched by veins and disseminations of bro-

ed henceforth on a large scale as a mass of low-grade leachable ore. Hitherto the friable brochantite and atacamite have been loosened by rough crushing and passage through screens, the concentrate being shipped to Swansea, to be there smelted in the usual way. Now wet methods will be applied. This is due to a recognition of the real character of the ore. At one time it was assumed that the copper existed as atacamite, the oxychloride, but it was ascertained in 1911, by Mr. Claude Vautin, that it was brochantite, a basic sulphate, named after Brochant de Villiers. Many specimens in museums labelled 'atacamite' are really brochantite. Both are emerald green minerals with a vitreous lustre, the quickest test being to heat a particle in

the edge of the Bunsen flame, when the atacamite immediately colours it an intense green. Experiments have demonstrated that the copper in this ore is soluble in cold dilute sulphuric acid after a coarse crushing. The loss of acid, due mainly to the presence of lime, is more than compensated by the generation of acid from the copper sulphate during electrolysis, the gain being 10 pounds of sulphuric acid per ton of ore treated. It is pro-

chlorine from the electrolyte is indispensable, not only on chemical grounds, but to protect the health of the workmen. Each leaching-vat will have a capacity of 281,600 cubic feet, and will be made of reinforced cement waterproofed with asphalt mastic. As the outcrop rises to 300 feet above the valley bottom, and a difference of 300 feet in level is available between the north and south end, it is possible to excavate the orebody by steam-shovel on a



OF THE CHILE COPPER COMPANY.

posed to eliminate the chlorine from the atacamite and the salt by precipitation on shot copper, but we expect that Mr. E. A. C. Smith, who has the matter in hand, will devise some method even better. Electrolytic precipitation of the copper is to be effected on trial-sheet copper cathodes in conjunction with fused magnetite anodes. These anodes are a recent German invention, presenting the advantage that they can be used in the presence of both chlorides and sulphates. The mention of salt hints at an interesting fact, namely, that free sodium chloride is found on the surface and in the veins down to 150 feet. This suggests the descent of the surface drainage in an arid region characterized by extremes of temperature. The elimination of all the

large systematic scale. The originator of the enterprise appears to have been Mr. A. C. Burrage, by whom it was introduced to the firm of M. Guggenheim's Sons. Some knowledge of the deposit had already been obtained by Mr. Pope Yeatman, engineer to the Guggenheims at the Braden copper mine, also in Chile. In effect, therefore, the man who started the ball rolling in big-scale Chilean copper mining was Mr. William Braden. A sum of \$500,000 was spent in preliminary prospecting and testing. Before floating the Chile Copper Company, to which the Chuquicamata was transferred, the Guggenheims spent \$3,000,000 and developed 100,000,000 tons of ore by drilling. In April, 1913, they made an issue of \$110,000,000 in shares, keep-

ing 95 millions for the vendors and selling \$10,000,000 worth of 7% convertible bonds to procure working capital. While over 200,000,000 tons is reasonably assured, it must be remembered that the bottoms of most of the drill-holes are still in ore and the full width of the lode-channel is yet to be ascertained. Mr. Yeatman stated, as recently as May 19, that 300,000,000 tons of 2'10% ore is likely to be indicated at an early date. A plant to treat 10,000 tons daily is being constructed; this would mean 3,500,000 tons per annum or a life of 60 years. So long a period for realization is uneconomical, therefore Mr. Yeatman has advised that the capacity of the plant be trebled. On this basis it is estimated that the cost will be 6 cents per pound, or £27½ per ton, on a 90% extraction; then, if the price of copper averages 14 cents per pound, or £65 per ton, the profit would be \$2'50 per share per annum for the 10,000-ton plant and \$6'73 for the 30,000-ton plant. These are not the reckless estimates of an untechnical promoter but the considered calculations of a trustworthy engineer; therefore they are intensely interesting. It only remains to add that this vast enterprise has been rendered practicable by two improvements of recent origin: the cement tanks and the magnetite electrodes. No better example than the Chuquicamata could be instanced to illustrate the immediate value of science when applied to industry by men of experience.

Waiting.

A French proverb says that "all things come at last to him who knows how to wait." *Tout vient à point à qui sait attendre.* Not to the man who rests supine or adopts the Micawber attitude of hoping that something will 'turn up,' but to the sagacious individual with the good sense to utilize the time of waiting in preparation for the sudden call of opportunity. The subject, unfortunately, is at this time one of personal interest to a large num-

ber in the mining profession. Waiting has been forced upon them. It happens also to be the policy of the world at large at this juncture, from the 'Wait and See' of Mr. Asquith at Westminster to the 'Watchful Waiting' of Mr. Wilson at Washington. We do not undertake to proffer advice to statesmen occupying positions of anxious responsibility, and aware, better than anybody else, that the result of the waiting depends upon the use to which they put the interval before action, but we venture, out of experiences of our own, to give a word of advice to the young engineer now unemployed. We have been there; we know what times of depression and unemployment mean to the eager spirits that are suddenly brought to a full stop. Consider the proverb: use your time of waiting. If you are still on the pay-roll, or can otherwise afford the expense, go to mines and smelters, taking advantage of the present interval to learn something new, the application of which may help you in future years. If a metal-mining engineer, you might go to Wales and study coal-mining methods, which are suggestive to those engaged in exploiting flat lodes. If you speak French, go to France and visit the gold mines, where you can see cyanidation applied to arsenical pyrite. There is Norway, where hydro-electric chemistry and metallurgy flourish. Or Spain, where there are other copper mines besides the Rio Tinto, to which access is usually denied. In the big chemical works in Lancashire some useful ideas may be gathered. In Cornwall, besides pilchards and golf, there is a tin mining industry that furnishes many examples of how to do some things and how to avoid doing others. In short, young man, driven out of Mexico, released from the Rand, or on furlough from Nigeria, you have the chance to enlarge your knowledge within easy radius of London. To do so is vastly more profitable to mind and body than to dawdle at a club or loaf in a City office. If circumstances, finan-

cial or otherwise, prevent you from making such journeys of observation, you can make those journeys of the mind that are available to every educated man. Instead of a ticket, take a book. Instead of a railway-station, go to a library. This is the time for you to furbish your technical equipment, and to become up-to-date in current technology. It is the time also for the culture that comes of wider reading. Read Huxley, and learn to express yourself clearly. Read Darwin, and appreciate the value of close observation. Read Tyndall, and open a window into the infinite. And if that seems advice too obvious to be acceptable, take a special course in advanced metallurgy or go again to a school of mines and learn the latest in surveying. Do something that may help to maintain or increase your efficiency. Don't loaf. Idleness is a rust that corrodes the mental machinery. Keep fit. Be ready for the opportunity that comes to him that knows how to wait.

Copper Hydro-metallurgy in America.

So much study and experimental work are now being directed toward the solution of the perplexing problems incidental to the extraction of copper from its ores by wet methods that it is desirable to review, from time to time, the progress made. The number of proposed processes is legion, but the most promising work involves the use of sulphuric acid as a solvent. The employment of chlorine, hydrochloric acid, or chlorides is the basis of numerous methods, and it is possible that in some instances it will prove successful; but, in most cases, it is not promising, since the attack on minerals other than copper, and consequent fouling of the solution, is greater with chlorides than with sulphates. The copper itself forms oxychlorides, which are a source of much trouble, and the precipitation of copper from a chloride solution offers more difficulty than from a sulphate solution. When gold and silver are present, the use of chlorides,

either with or without sulphuric acid, may be necessary to recover the precious metals, but it leads to difficulties, and should be avoided if possible.

The use of sulphuric acid as a solvent for copper minerals presents three difficulties. In the first place, the acid will not attack metallic copper, the sulphides, or the arsenides. Since nearly every body of oxidized ore contains one or more of these in considerable amount, simple treatment of the ore as mined will not dissolve more than a part of the copper present, and the operation is not likely to be successful, as too much of the copper content escapes in the tailing. This method therefore is confined to surface ores, which are so completely converted into oxide or carbonate as to be completely soluble, and to those sulphide ores that can be given a preliminary roast. In some cases the sulphide minerals can be recovered by wet concentration, and the oxidized tailing treated with acid. This indeed is likely to be the normal procedure. The ore, a mixture of sulphides and oxides, by being mined and milled cheaply, yields a considerable quantity of copper at a low cost per pound of metal produced. The tailing from this operation then becomes the raw ore for the next step in the process, and as it has to bear no charge for mining, transport, or crushing, these having been charged to the preceding operation, it becomes possible to perform the necessary subsequent operations, such as roasting and leaching, at a profit, whereas if these were applied to the whole mass of the ore the net result would be a loss. Roasting sulphides preparatory to leaching involves numerous difficulties, such as the production of ferrite of copper, volatilization of copper chloride, if chlorides are present, and other complications.

Assuming that the copper minerals can be dissolved successfully by the use of sulphuric acid, we come to the next difficulty, namely, that the acid dissolves a variety of other com-

ponents of the ore as well. Soluble iron, manganese, and aluminium minerals yield the corresponding sulphates, and these may accumulate in the solution to such an extent as to compel the rejection of part of it daily, leading to loss of acid. Sulphuric acid is a comparatively cheap reagent, costing \$5 to \$7 per ton at those smelters in the United States where it is being manufactured, and, to those accustomed to the use of so expensive a reagent as potassium cyanide, the loss may seem immaterial, but it must not be overlooked that the proportions involved are different. Probably the richest material that has ever been treated by cyanide contains 65 to 70 ounces of metal per ton, and cyanide solutions containing over 15 or 20 pounds of potassium cyanide per ton are unusual. In the hydrometallurgy of copper, the ore contains 15 or 20 pounds of metal per ton, and the solution contains 175 to 200 pounds of sulphuric acid. The relative masses involved thus constitute an important point of difference.

When finally the copper is dissolved, the problem is to extract it in usable form. This can be done in a variety of ways. The oldest and simplest is by precipitation with iron. Theophrastus relates how the peasants in Hungary in the 16th century used to throw iron into sundry springs, and in the course of time it was transmuted into copper. In present practice at Rio Tinto, Butte, Clifton, and at numerous copper mines throughout the world, iron is being used to precipitate the copper from sulphate solution. The conditions at Rio Tinto and Butte are unusual, and the practice there could not be extended to general use. Where this method is applied in a small way it affords a convenient disposal of accumulations of scrap-iron and steel, but working on a large scale the iron must be procured for the purpose. Pig-iron contains carbon, silicon, phosphorus, and sulphur, all of which contaminate the copper precipitate. Furthermore, the amount of iron practically required

to precipitate copper greatly exceeds the theoretical amount, ranging from 2 to 3 pounds of iron per pound of copper. Iron is cheap, but it is not free, and this forms an appreciable item of cost, say 2 to 3 cents per pound of copper. Since few companies will admit a greater total production cost than 10 c. per pound of copper, this is a large item. The most promising work centres around the method first developed by Mr. L. D. Ricketts, and more recently by the staff of the Anaconda Copper Co.; this involves the reduction of the iron oxide of the roasted ore, after leaching, to metallic iron in reverberatories, without fusion. The spongy iron thus produced may be used for the precipitation of copper and the problem is to develop the technique necessary to carry on the operation at a profit. Obviously, unless the roasted ore consists essentially of iron oxide the resulting precipitate will be impure; and the complete reduction of the oxide is necessary, otherwise it will remain in the precipitate, with the same result.

Electrolytic precipitation of the copper presents new conditions. In electrolytic refining the solution is rich in copper and comparatively free from impurities, but even there the removal of impurities is a large factor in the total cost. The most important difference between refining and precipitation is that in refining the copper is merely transferred from the anode to the cathode, while in precipitating the copper must be thrown out of the solution. The acid radical liberated at the anode makes a vigorous attack upon it, and for a long time it was impossible to find any substance sufficiently resistant to this attack. In the experimental work for the Chile Copper Co. done under the direction of Mr. E. A. C. Smith, this difficulty has been overcome by the use of fused magnetite electrodes, made at Frankfort. These are hollow (to reduce the weight) 5 inches wide, 2 inches thick, 4 ft. long, with $\frac{1}{4}$ -inch walls, and are plated with copper on the inside to make them better con-

ductors. While somewhat expensive as to first cost, they give excellent service. At this plant the solution, containing 5% of copper as sulphate, will be electrolysed down to 1.5% copper content, and will then be used to leach again. Another difficulty in electrolysis is that when copper, iron, and sulphuric acid are present in a dilute condition the copper is present in the form of cuprous sulphate and the iron as ferric sulphate. When this solution is electrolysed, ferric sulphate remains, and being a solvent for copper it attacks the copper on the cathode, taking it into solution again. Energy is thus consumed and the net result is that of a puppy chasing his tail. Various remedies have been proposed: the use of porous diaphragms, which increase the resistance and the power consumption, the use of depolarizers, which introduce complexities, and so on. And always there is the difficulty that the solution is not rich in copper salts, and thus has a comparatively high resistance. The copper present cannot be precipitated completely without an enormous consumption of energy to remove the last traces of the metal. It becomes necessary to use solution containing one or two per cent of copper for leaching, and a considerable amount of metal is locked up. Where undesirable impurities are present the difficulties are intensified. It is not likely that in many places the conditions will be so favourable as at the Chile Copper Co., where it has been found that no arsenic, antimony, or bismuth is present, and the iron content of the solution does not build up beyond 3.7 grammes per litre, a concentration offering no difficulty. In short, it is perfectly feasible to precipitate copper from solution by electrolysis, but to do it cheaply is another matter. The Chile Copper Co. is fortunate in that its ore consists of an easily soluble hydrous sulphate, the mineral brochantite, free from impurities; moreover the operations of mining, transport, and crushing can be done so cheaply that it does not much matter if the

cost of precipitation is rather high, as the total is still small, it being estimated that the copper will cost 6 cents per pound or £28 per ton, delivered in Europe.

An interesting method which is in process of experimental development is the use of sulphurous acid to precipitate copper from sulphate solution. Under proper conditions of temperature and pressure, if sulphurous acid is passed into a neutral solution of copper sulphate the copper is precipitated and sulphuric acid is generated, and as the acid produced is in excess of that consumed in the leaching the problem of cost of acid is reduced to its simplest possible terms. The difficulties of this process are obvious, and it remains to be proved by actual experience whether the handling of hot solutions at a high pressure can be conducted at a cost sufficiently low to yield an operating profit.

Ore.

Like Banquo's ghost, this is a subject that will not down. It rises to disturb the equanimity of those that desire to use technical terms with accuracy. Nor do we regret the publication of anything that tends to clarify ideas on the matter. Hence we welcome Mr. Walker's contribution, which is that of a detached but sympathetic onlooker. Prompted by his support, we ask again: How can the mining engineer eliminate the idea of profit or economic advantage from the meaning of 'ore'? It is clear that so venerable an authority as Von Cotta read into it the notion of commercial gain, for if ore be a mineral aggregate that "attracts the attention" of the miner, it may be assumed that the attraction is based not on colour, cleavage, or crystallization, but on the probability of winning the equivalent of money therefrom. Most of our critics have allowed this fundamental concept to peep out of their definitions, while objecting, in some cases, to a plain recognition of it.

We have not been conducting this discus-

sion in the interest of the man in the street or the noble lord who sheds the phosphorescent lustre of a decaying name upon the pages of a prospectus; we have attacked this verbal problem in behalf of the mining profession, believing sincerely that precision of terms leads to the clear thinking so essential to technology as applied to business. It is imperative that technical men, and those that follow them, should use at least three words with thorough understanding. Those three keywords are 'ore,' 'cost,' and 'profit.' On the correct interpretation of them depends the entire superstructure of the financial operations incidental to mining. So long as those engaged in the industry, and more particularly those in the lead, namely, the mining engineers, employ such terms carelessly, we shall flounder in a morass of misunderstanding and misstatement, highly prejudicial to legitimate success. We are not trying to amend the English language or to change the common usage of a particular word; our effort is directed toward establishing the technical meaning of a technical term, so as to arrive at a definition that will recognize realities. We agree that "usage is the law of language," but we differ from our critics in the interpretation of that dictum. Whatever the geologist or the mineralogist may mean by 'ore'—and with them, we submit, it is usually merely a synonym for a mineral aggregate—it seems plain to us that the scientific miner, that is, the mining engineer, takes it to represent something of economic value, not only to the community that may make use of it, but to the individual or company that exploits it. We do not ask the geologist, the mineralogist, or the general reader to change his usage; with none of these are we concerned; our appeal, we repeat, is to the mining engineer; we urge him to preserve a verbal coin of standard value and to restrict the use of it to an exchange of ideas as old as the art of Agricola.

The business of mining begins with the

query: "Is it ore?" and it ends with the statement: "The ore has been exhausted." When a mineral deposit is presented for exploitation to a capitalist—small or large, a group of working miners or a big house in the City—the first question asked is whether it can be exploited to advantage, in other words, what proportion of the deposit can be extracted and beneficiated for a yield in excess of the total cost. How much of the mineral deposit is really 'ore'? In asking these questions the capitalist has in mind a given time, namely, the near future, and a given place, namely, the locality in which the deposit is reported to exist. For a reply to such questions we go, not to an archbishop or an architect, but to a mining engineer. He is the man specially equipped, by training and by experience, to guide us amid the technical difficulties appertaining to mining. We might go to the vendor, the promoter, the miner, the director, the solicitor, or the accountant, all of whom may be supposed to know something concerning the matter in hand. The vendor's ideas are usually independent of time; the promoter's, of place; the miner can tell how much labour must be expended in breaking the mineral, but he knows little about the beneficiation and realization that follow. The director, solicitor, and accountant know enough to know that they don't know. Hence they, acting in behalf of the shareholder or putative purchaser, retain a mining engineer to tell them whether the mineral is ore, how much of it there is, and what ultimate gain therefrom may reasonably be expected. Anyone who can answer these questions is a mining engineer, and one that answers them accurately is an accomplished mining engineer; for behind the reply must rest a whole world of knowledge and experience. In short, we come to the conclusion that a mining engineer is one that can distinguish between 'mineral' and 'ore.' The man who can say what is ore is a mining engineer. It only remains for him to say what ore is.



SPECIAL · CORRESPONDENCE

TORONTO.

Calgary Oil-Field.—The Cobalt and Porcupine mining districts engage but little interest at present, being superseded as centres of attraction by the Calgary oil discovery. Capitalists and prospectors from all quarters are flocking into the field, new companies are being organized by the score, and numerous sales of oil-lands at high figures are reported. At the Dingman well a 12,000-gal. tank has been built, and on June 4 the well was uncapped, with the result that 2000 gallons poured into the tank in 18 minutes at a pressure of 270 lb. per square inch. It was decided not to leave the well open for any length of time until machinery for handling the amount of gas escaping with the oil arrives, as the gas is valuable. The uncapping of the well in the presence of a large crowd of visitors was undertaken to set at rest reports that the discovery was not genuine, and that the well had been faked. Oil taken from the well is being sold for motor use at about \$13 per barrel, which is stated to be the highest price ever obtained for crude oil.

Reginald W. Brock, Deputy Minister of Mines for Canada, who is an expert on the subject of oil and gas formations, has inspected the field and issued a statement embodying the result of his observations. He warns investors that the strike, though it may be an event of importance as strengthening the conviction of the Geological Survey that the West affords a highly promising field for oil prospecting, does not establish the existence of an important commercial field. The finding of a white oil, about 64° 5° B, almost pure gasoline, is not as satisfactory an indication as a similar strike of crude oil. White oils are generally limited in quantity, representing the lighter and more volatile portions that filter from the main body. Taken in connection with the encountering of a small quantity of similar oil last fall, it leads to the supposition that the drill is approaching the main reservoir. The area for prospecting is limited east and west. The Dingman well is located on the apex of

an anticline or fold in the rocks that runs north-west and south-east, or parallel with the front of the mountain, toward which the formation becomes too badly disturbed and broken to hope for successful prospecting. While the surface rock on the anticline is Cretaceous, in which formation all possible oil-bearing rocks occur, the Tertiary strata of the plains on the East are unfavourable, as any oil-bearing strata are so deeply buried as to be out of reach by the drill. The altitude of the anticline favoured the operations of the company, as oil rises to the highest point permitted by underground conditions. Mr. Brock's conclusion is that it is only a comparatively narrow belt with a trend roughly parallel with the mountains that offers any reasonable prospect for oil. He strongly advises investors to assure themselves that the company has sufficient capital to put down several wells, and that their operations are directed by some expert of repute who has carefully examined the ground and pronounced it worth prospecting.

Should the expectations excited by the discovery be justified by results one effect will be enormously to increase the value of the holdings of the Canadian Pacific Railway, which holds extensive mineral rights in the neighbourhood, some of them covering lands situated on the Dingman anticline. In selling their lands to settlers the company has carefully reserved all mineral rights, and, even with the limitations assigned to the field by Mr. Brock, their holdings will be worth many million dollars, and, with their transport facilities, they will practically control the field. It goes without saying that the Standard Oil Co. is seeking to acquire control. The Imperial Oil Co., the Canadian branch of the Standard, has representatives at Calgary. It is understood that they wish to secure the output of the Dingman well and ship it to their refinery at Burrard Inlet, near Vancouver, to mix with the cruder oils.

On June 1 the depths attained by the leading wells in the field were as follows: Dingman 2718 ft., McDougall-Segur 2450 ft., Black

Diamond 1580 ft., United Oils 1570 ft., British Alberta 1520 ft., Southern Alberta 800 ft., Monarch 640 ft., Federal 480 ft., and Western Pacific 300 ft. The Province of Alberta is taking steps to prevent investors being duped by wild-cat companies, though its action is not so drastic as that of Manitoba. The police has been instructed to suppress all misleading advertisements of oil shares either in the newspapers or in the form of posters, and to prosecute offenders, who are liable to a penalty of \$250. Some companies have also been called to account for doing business without being registered as required by law.

SAN FRANCISCO.

Exposition.—Rapid progress is being made in preparation for the Panama-Pacific Exposition and if there are unfinished buildings on the grounds when the gates open next February, it will not be the fault of the management. All the main exhibit palaces have now been built except the Fine Arts building and here the steel is being erected. The other buildings are all under roof, merely the towers and decorative features remaining to be built. The Machinery building has been finished since last autumn and has been in use repeatedly for the pageants and *fiestas* to which San Francisco runs. Now the sculptor's workmen are being cleared out and the first of the exhibits are being set. Something of the size of the structure may be inferred from the fact that it has been used for aviation meetings and one exhibitor of Diesel engines who applied for central space now finds he must furnish an exhaust pipe 150 ft. long to pierce the ceiling! Across the way is the Mines and Metallurgy palace, which extends over two acres and in which space is already at a premium. Among notable exhibits to be placed here is to be one by the United States Steel Corporation in which the whole business of that great concern from mining iron ore in Minnesota to selling steel products in South America will be shown. The Standard Oil Co. will have an equally complete exhibit of oil production and refining illustrated by maps, models, charts, and specimens. Outside the building the Union Oil Co. will build a complete oil camp and will have in operation drilling rigs, pumps, and a small refinery. Large space in the building will be occupied by the Government exhibit, including especially displays made by the Geological Survey, Alaska, Bureau of Standards, and Bureau of Mines. One attractive feature will be a model mine to be built under the floor of the building and

supervised by the U.S. Bureau of Mines. This mine is to consist of a series of stopes on the metal side, and of rooms on the coal side, each contributed by a mining company and illustrating typical conditions in that mine. For example, the Lehigh Valley Coal & Navigation Co. will show the mining of anthracite coal. The Pocahontas Fuel Co., Pacific Coast Coal Co., Consolidation Coal & Coke Co. of Kentucky, and probably others will exhibit typical workings in the bituminous fields. The Bunker Hill & Sullivan M. & C. Co. will show a Coeur d'Alene lead-silver stope; the Homestake mine will illustrate its method of work; the Copper Queen will reproduce a stope in the great mine at Bisbee; a number of the Lake Superior iron companies will join to illustrate iron-mining, and other combinations are in prospect. While head-room will be scanty and space limited to two acres, it is believed that typical illustrative phases of mining can be shown. It will be made all the more realistic in that the various machinery manufacturers have generously agreed to contribute a hoist, cages, cars, track, pumps, lights, drills, coal-cutters, locomotives, and everything else necessary to make the exhibit complete. Among the firms taking part are the Denver Engineering Works, Joshua Hendy Iron Works, Westinghouse Mfg. & Elec. Co., U.S. Steel Corporation, Byron Jackson Iron Works, Compressed Air Machinery Co., Ingersoll-Rand Co., California Cap. Co., and many others. Support for the exhibit is coming forward rapidly and the mine seems now much surer of success than many a lean prospect that has lived to pay big dividends. Not all the mining exhibits will be housed in the Mines and Metallurgy building. Among outside affairs is to be a copper-smelting test-plant operated by the Bureau of Mines and supported by the copper companies; in this serious work on smelter fume will be under way. Just as the St. Louis fair was the starting point for the excellent work on fuel investigations now being conducted by the Bureau of Mines, so it is hoped that the San Francisco fair will be the occasion for clearing away rubbish and getting down to bedrock preparatory to constructive work on fume control. The fact that F. G. Cottrell is in charge assures the serious purpose of the work. Near this plant it is hoped to have an ore-dressing establishment under charge of the Merrill Metallurgical Co., but plans are not yet sufficiently forward to permit definite statement. Mining men may be assured, however, that when they visit the Exposition grounds next

year they will find not only beautiful buildings, usual exhibits, and unusual amusements, but will also find much worth while from the technical point of view.

Oil.—Oil men generally on the Pacific Coast have taken with equanimity the reports from London of the Grenfell failure. Few apparently know whether it will seriously affect the Western Ocean Syndicate, which was financing the General Petroleum Company. E. J. de Sabla has left for London to investigate. He apparently hopes that advantage may be taken of the situation to make better terms for the stockholders of General

cited. However, it is to be remembered that the largest wells previously brought in there yielded only 300 to 400 bbl., and that the total production of the Japanese empire has previously been just about equal to the output of this one new well. California operators are interested from more than one standpoint. In the first place a sufficient supply of oil in Japan would probably encourage more trans-Pacific steamers to discard coal, and California would supply them with oil on all west-bound trips. As it now stands the lines to China and Japan still burn coal rather than carry oil for the round trip. In the second place the new well



THE EASTERN DRIVEWAY, PANAMA-PACIFIC EXPOSITION.

Petroleum. In general there is a cheerful feeling that the money really necessary will be forthcoming as needed, and the fact that H. C. Hoover is at the seat of trouble helps this feeling. Incidentally the fact that No. 2 well is flowing again at the rate of 10,000 bbl. helps General Petroleum officials to look on the bright side of things. This is an old well recently re-drilled. When it 'came in' it was with such force as to be beyond control and to lodge in the top of the rig a boiler that got in the way of the stream of oil. It is interesting to observe the effect of contrast. In California this 10,000-bbl. gusher running wild hardly got a headline in the papers, and the fact that in the last four months the Standard Oil Co. has brought in three wells flowing 10,000 bbl., 12,000 bbl., and 15,000 bbl. respectively has created little comment.

At Akita, Japan, in May a 14,000-bbl. well was 'brought in' and the whole country is ex-

was drilled with a rotary machine bought in California and with a crew either consisting of men from here or Japanese taught by them. It will be remembered that drilling in the soft Tertiary beds of the Echigo field was found difficult and expensive. It was not till officials of the Nippon Oil Co. visited California about two years ago and secured machinery and men for rotary drilling that rapid progress could be made. Since then drilling has gone forward and several wells have been brought in, though none so good as that at South Akita.

Canadian Oil.—Another foreign field that is much discussed here is that at Calgary, in Alberta. In general California men who have visited the field are inclined to go slow. The grade of oil found in the Dingman well is surprisingly high, 64° 2 B, but the amount is not certainly known and is believed to be small. It is significant, possibly, that the owners have pro-

vided a 1000-gallon (not barrel) tank in which to store the output. The well was started in the Bearpaw shale and the oil is from the bottom of the Judith River or Belly River formation. These formations are well known and have been much studied along the eastern front of the Rocky Mountains from Wyoming north. The Judith River is a fresh-water formation with coal in its lower portions. It is believed that the oil really originated in the underlying Claggett and Benton, which latter especially yield oil in moderate quantities at a number of points from Colorado north. The high grade of the product is extremely suggestive of separation by diffusion during migration and so far favours Cunningham Craig's idea of a possible reservoir of crude oil below. However, the American geologists, at least, having in mind the many disappointments south of the line, are not especially hopeful of a big body of crude oil in the Dakota. Instead, some such supply is anticipated as has been found in sand lenses in the Benton shale at several points in Colorado and Wyoming, valuable fields but nothing to warrant abandoning all other industry and allotting to 'oil' companies all the land for 60 miles around the well. In fact the territory worth testing is estimated to be 700 ft. wide and 3 to 10 miles long. The whole front of the Rockies here, as R. W. Brock points out, warrants study with the purpose of finding similar anticlines suitably situated for oil accumulation, and it is reasonable to hope for a considerable production from Alberta. One might hope that right heartily, however, and still be unwilling to pay \$500 per acre for land 30 miles from the discovery without regard to whether the particular acre was over an anticline or a syncline.

MELBOURNE.

Flotation Processes.—Nothing in Australian metallurgy today attracts more attention than the steady development of the flotation process. Of late, however, there has been a tendency to overshadow the solid work of some of the most earnest and successful experimenters just as in the early days. Potter failed to get the prominence he deserved. The big bell is often to be heard, especially in certain quarters of Broken Hill, directing notice to what is being done at one claim or another, but the same attention is not called to progress at other properties, notably, the Zinc Corporation or the Broken Hill Proprietary. The former company is placed first because of the greater range of experimental work by

the general managers, Bewick, Moreing & Co. The investigations by Mr. F. J. Lyster ought to be historical for the part he has played in the development of the selective process. For the past two years the Zinc Corporation has been producing a high-grade lead concentrate from slime that previously baffled the whole of the technical men of the Barrier who had been endeavouring for long past to handle this calcitic material. Prior to Lyster's discovery, Mr. E. J. Horwood, manager of the Broken Hill Proprietary mine, obtained a patent for the selective separation of zinc and lead. Incidentally the Horwood process was taken up by the Zinc Corporation, and is today an established success. The material, however, that this process is treating is a high-grade zinc-lead slime, which is a by-product on the re-concentration by tabling of the primary flotation concentrate from the Minerals Separation process. The Zinc Corporation is treating about 400 tons per week of this material, and considerably enhancing the value of the product.

The calcite slime that Lyster beneficiated was not amenable to the Horwood process for the following reasons: (a) it was too poor; (b) the calcitic nature necessitated the absorption of an abnormal quantity of sulphuric acid in the subsequent flotation of the roasted slime. Lyster found that by simple agitating in the presence of a water containing minerals in solution he could control the right degree of agitation required to show a preferential separation of the galena from the blende particles, and that without the use of acid. By his method the galena is first floated, thus leaving behind the calcitic zinc residue, which can be concentrated by thickening the slimy residue and re-treating in fresh water solution also with the use of an essential oil as an emulsifier.

Following on Lyster's inventions came a number of other patents, but I desire to emphasize the fact that Lyster was the first to demonstrate how galena and blende could be selectively floated without recourse to roasting, whereby the sulphatizing of the galena is not necessary preparatory to flotation, as in the Horwood process. Credit is due to Mr. J. D. Owen, of the Junction North mine, for a further modification of the flotation process by which he has attained the effect of Lyster's method. This he has done by means of a high degree of aeration. The aeration, however, is mechanically controlled, and calls for a greater absorption of horse-power than is necessary with the Lyster process. A third

process also is in the field, the invention of that indefatigable investigator, Mr. Leslie Bradford, of the Broken Hill Proprietary Company. He works on lines quite different from Lyster or Owen. His plan is to agitate the slime in a solution of common salt in the presence of a small percentage of sulphuric acid. Unlike the other selective method, the blende is floated first and the galena remains as a residue. A high degree of concentration is claimed for this process, and at the present time the Proprietary company is working an experimental unit on it, and whatever may be the claims of the different discoverers, one fact that stands out prominently in connection with the development of the selective flotation

ore in the property, draw the pumps, and then treat the residue at the surface. It was expected that this policy would admit of a return of about £50,000. As the company has put up working capital of well over £200,000 without getting a dividend, they can be said to have earned the right to end their career their own way. Tasmanians, however, do not want to see the mine stop. They challenged the accuracy of the diagnosis made by Messrs. Heathcote and Llewellyn. In the end the State Government agreed to appoint Messrs. J. H. Fawcett and W. H. Cundy to report on the property. Their finding has now been published, and it bears out to the letter the recommendation of the management to close-



BROKEN HILL.

process is that Bewick, Moreing & Co. and their staff have to be credited with being the first to demonstrate its use on a commercial scale at Broken Hill. Their success has resulted in the recovery achieved at the lead mill of the Zinc Corporation becoming a record for the world. Therefore, it was fortunate that the company secured not only the Lyster process but also acquired the Horwood process for the treatment of lead-zinc slime.

Tasmania.—One of the most unfortunate deals in which British investors have participated in Australia is the Tasmania mine at Beaconsfield in northern Tasmania. Acting upon the advice of the general manager, Mr. C. F. Heathcote, and of Mr. Arthur Llewellyn, of the staff of John Taylor & Sons, of London, the board decided to extract all the

down the property. They agree that the indications on the bottom level are not sufficiently promising to induce them to say that the capital required to open-up another level and to subdue the incoming water should be subscribed by the shareholders. That being so, the property seemed to be doomed, but the Labour Government of the State is not prepared to see an exodus of workers from the locality. Accordingly they have agreed to subsidize parties of tributers by granting £1000 per month to cover the cost of fuel, stores, and management, as well as to pay £50 per week rental to the company. The men wanted to manage the mine, but the Ministry would not tolerate that, and it also takes the right to terminate the agreement at a month's notice. The first proceeds of the gold are to

go to recoup the State on its outlay. Then the men will receive the balance, which, it is thought, will give them good wages. Of course, this scheme can only be an expedient, for it would take £50,000 to open-up a new level, and the State will not provide that amount of cash. The last returns of the company were about $7\frac{3}{4}$ dwt. per ton.

Tin.—The fall in the price of tin has not altered the attitude of Australian investors toward the East. The pioneers were a band of Tasmanians, mostly people who went to the Malay Peninsula to sell jam. Being endowed with imagination and business aptitude, they saw that the dredge could be used to raise tin cheaply and on a large scale. After the preliminary financing had been done, the two pioneer companies, the Tongkah Harbour and the Tongkah Compound, have never had cause to look back, so that today they represent a pair of highly prosperous enterprises. While this is so, it is a question whether they have not reached their zenith. All the same, the work they have done has had a wonderfully stimulating effect on investors on this side. Accordingly, they are sending out prospectors to the Federated Malay States and to Siam to prospect and pick up any bargains that may be available. Allusion has already been made in these columns to the interest taken by people in London in one Renong property. Sydney people have obtained large areas in the same locality, and it is amazing to hear how block after block is said to average at least 2 lb. of tin oxide per cubic yard. In all these estimates one wants to know how the boring was done, what was the basis of estimation, and also whether the sampling was checked. In the majority of instances the dredges to be supplied are to be Australian built, but in one or two cases American plants are under order. If dredge results should reach 2 lb. per cubic yard then the companies cannot fail to do well. That, however, has to be proved, and it has also to be demonstrated that clay, which has so troubled some of our Australian companies, is absent.

Broken Hill.—The declaration of a dividend of 6s. per share by the South company hit a good many people fairly hard. During the past quarter the price of lead has maintained such a figure as to permit of profits being at the level of the previous quarter, when 8s. per share was paid. But boards of directors cannot control indigent treasurers with a submissive party at their back. In New South Wales the Labour Government has decided to impose an income tax equal to 5 per

cent. This, with the royalty, makes a total charge of 6% on the profits of the companies. In the case of the Broken Hill South company the income tax for 1913 amounts to over £14,100. One of the directors has made public protest against the charge, and it is only fair to say that he has put a fair case for public consideration. But it has to be remembered that the special object of the tax is to reach the full profits of the companies. Previously shareholders had to pay individually, and if their income, including their dividends, did not come up to the minimum income taxable by the State then they escaped. Now the companies have to pay on the full profits, and there is a large section of the taxpayers here who regard the present method of collecting the income tax as being far more just than one that permitted evasion. Then, too, the Broken Hill companies are wealthy, and the shares are mostly held outside New South Wales, chiefly in Great Britain and in Europe, so that the protest is not backed by strong public opinion. Without that it can carry little weight. Indeed, in the Labour camp the Broken Hill companies are not viewed with too much favour, and a hard-up treasurer may even go further still on the Lloyd George mission of "making the fat man sit up."

At Newcastle, in New South Wales, the Broken Hill Proprietary company is erecting its iron and steel works with the utmost expedition. A recent shipment of 7000 tons of plant from the United States was delivered, and another 4000 tons is expected to arrive in a few weeks' time. In the meantime the blast furnace is up and a portion of the mill and other sections of the different units are being assembled as rapidly as is possible. The company, however, has still a great deal of work to do, especially as the site of the mill is such that pile-driving has been found necessary. Still, officials say that the plant will be ready by the end of the year, and it will be well for the company if this forecast is not too sanguine, as a good many people think. The company apparently has not yet come to terms for the sale of its Port Pirie works, and, failing an announcement, the question is being put as to how the cost of the balance of the enterprise is to be financed, whether by debentures or by a fresh issue of shares. The most disturbing factor at the moment is the definite statement that the Labour Government of New South Wales has been inspecting the iron and steel works of the Messrs. Hoskins, at Lithgow. There fuel and ore are almost side by side, while a

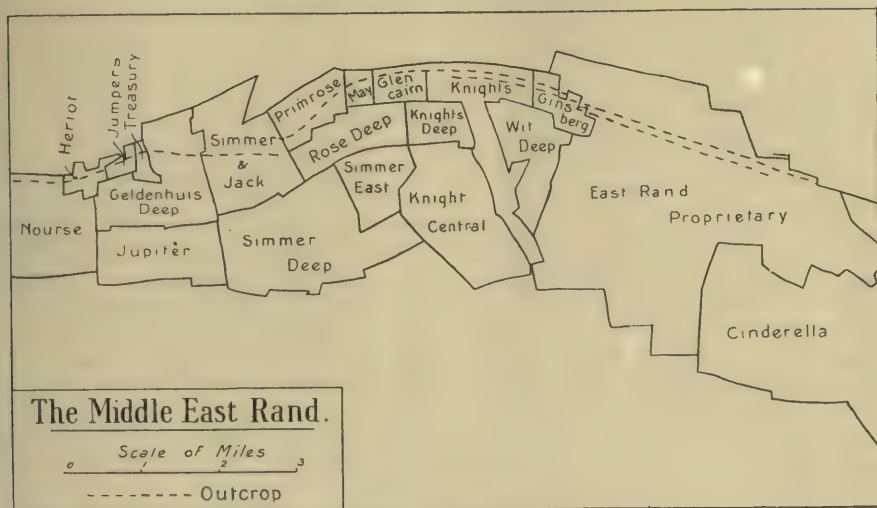
little distance away is the huge deposit of iron ore at Cadia. This belongs to the Scottish Australian company of London, and has been reported on most highly by the State geologists, so that, should the State determine to buy the Hoskins works, it will not want either for fuel or for raw material. The possibility of action in this direction has been foreshadowed in this column. Now the subject is within the realm of practical politics.

Copper.—Apart from Mount Lyell, the copper mining industry in Australia appears to be in a state of flux. There are no discoveries of importance, and it is clear that a great deal has yet to be done in Northern Queensland before that region reaches the pinnacle promised some time ago by its ad-

July. So, till after that date it is only fair to suspend judgment, especially as the staff is confident that larger outputs will be associated with extensive savings. The statement that changes in the staff were imminent has been officially denied by the chairman, Mr. R. G. Casey. In South Australia the Wallaroo & Moonta mines are maintaining their yields, though the fall in the price of copper affects profits substantially. But the great disappointment to the country is the inability of prospectors to find new deposits of ore.

JOHANNESBURG.

Recent Events.—A case of considerable interest to mining companies was decided in Johannesburg on May 15. The Consolidated



mirers. The Mount Elliott mine has practically exhausted its store of rich ore, and it will take time to bring the new properties to a productive stage. With the Hampden, too, the drain upon finances, due to the purchase of the Macgregor group, makes it exceedingly doubtful whether the company will ever see an adequate return for the price paid and the cost of the railway. Still, the management is hopeful that the outlying mines will provide supplies of ore for years to come. At the Great Cobar, in New South Wales, the question is how the capital will be forthcoming to fill the stopes and put the property in such trim as to yield profits. At Mount Morgan the opening of the new plant is awaited with intense interest. Some metallurgists hold that the abandonment of the use of copper-bearing fluxes was a mistake. Anyway, the wheels of the new plant are to go round in

Langlaagte Mines sued the Victoria Falls & Transvaal Power Co. for damages for breach of contract in failing to supply the plaintiff company with electric power. The damages as assessed by Professor Lawn, consulting engineer to the Consolidated Langlaagte, were, in substance, what the court accepted and the power company was ordered to pay £29,000 damages.

The miners of the northern section of the Randfontein Central Gold Mining Company showed poor judgment in asking the Transvaal Miners' Association to assist them in obtaining higher wages. While Mr. C. A. Ferguson, the company's general manager, was only too willing to discuss matters with his employees, he had most serious objection to outside interference, and politely declined to receive a deputation assisted by the association's representatives.

The colour bar has been vigorously discussed by almost all classes lately. Mr. Merriman, in the Union House of Assembly, advocated its removal from the mining regulations of the Transvaal and Orange Free State provinces. Labour members strongly opposed. With Assembly elections looming about a year ahead few really honest advocates of the system exist at present. All of this makes one wonder how many of the true labourers would wear shirts, if picking cotton by natives were suddenly to cease.

The annual exhibition held by the Chemical, Metallurgical, & Mining Society made 'Safety first' one of its chief features this year. Lectures were delivered by such well-known authorities as Mr. Cullen of the British South Africa Explosives Company on the handling of explosives, and Dr. Irvine of the Crown Mines on ambulance work.

Rose Deep had not quite so satisfactory a run as the year before :

| Year ended December 31 | 1912 | 1913 |
|-----------------------------|-----------|-----------|
| Tons milled..... | 782,200 | 786,070 |
| Yield per ton | 28s. 10d. | 26s. 3d. |
| Cost per ton..... | 17s. 5d. | 16s. 7d. |
| Profit per ton..... | 11s. 5d. | 9s. 8d. |
| Total working profit..... | £446,824 | £369,664 |
| Dividend..... | 45% | 42½% |
| Balance unappropriated..... | £55,134 | £74,706 |
| Ore reserve tonnage..... | 3,695,100 | 3,828,400 |
| Assay value per ton..... | 6'1 dwt. | 5'8 dwt. |

Striketroubles and consequent native-labour shortage resulted in a reduction of tonnage, whereas under normal conditions the mine would readily have exceeded the tonnage milled during the previous year. Trouble was experienced with the shafts, but this was successfully overcome, and many improvements, both on surface and underground, were carried out. Some 50,000 tons of sand was lowered for filling, while the spraying of the drifts with a solution of molasses assisted in settling dust underground.

Village Deep, though not showing the same degree of improvement as for the corresponding period in 1912, nevertheless had a satisfactory year :

| Year ended December 31 | 1912 | 1913 |
|-----------------------------|-----------|-----------|
| Tons milled..... | 596,900 | 535,300 |
| Yield per ton..... | 29s. 10d. | 29s. 10d. |
| Cost per ton..... | 19s. 11d. | 20s. 7d. |
| Profit per ton..... | 9s. 11d. | 9s. 3d. |
| Total working profit..... | £294,810 | £247,110 |
| Dividend..... | 17½% | 15% |
| Balance unappropriated..... | £57,559 | £49,768 |
| Ore reserve tonnage..... | 2,235,300 | 2,662,600 |
| Assay value per ton..... | 6'9 dwt. | 6'6 dwt. |

£23,488 of the 1912 profit is derived from reserve gold, also, 1641 ft. more development was carried out in 1913, accounting for some

of the difference. Hoisting is gradually being concentrated on the Turf shaft, No. 1 shaft already lowering all its ore there, and electric winders are superseding steam winders at No. 2 and 3 shafts. All drill-sharpening is done with Leyner machines. Considering the depth at which operations are taking place, the grade of ore developed is satisfactory.

Modderfontein B. had a most successful year :

| Year ended December 31 | 1912 | 1913 |
|-----------------------------|-----------|-----------|
| Tons milled..... | 388,570 | 404,580 |
| Yield per ton | 37s. 4d. | 38s. 9d. |
| Cost per ton..... | 17s. 8d. | 16s. 4d. |
| Profit per ton..... | 19s. 8d. | 22s. 5d. |
| Total working profit..... | £382,153 | £453,531 |
| Dividend..... | 20% | 45% |
| Balance unappropriated..... | £123,435 | £199,163 |
| Ore reserve tonnage..... | 2,594,000 | 2,800,400 |
| Assay value per ton..... | 7'2 dwt. | 8'3 dwt. |

As much waste as can be conveniently sorted in the flat stopes is packed underground, at a cost amounting to 10d. per ton milled. Development work was confined mainly to that portion of the mine lying south and west of the main shaft. In the disturbed eastern section, however, a winze sunk from an old prospecting shaft disclosed 16 in. of banket averaging 20 dwt. for a distance of 200 ft. The policy of the company is to extend development toward this large area of ground, untouched below the 2nd level, and comparatively unprospected above it. This is probably the only property on the Rand where the mill is hard-worked to keep in step with the mine, but this state of affairs will be remedied in September, by the addition of 16 Nissen stamps and one tube-mill.

Witwatersrand Deep showed a healthy recovery from its troubles during the last few years :

| Year ended December 31 | 1912 | 1913 |
|-----------------------------|-----------|-----------|
| Tons milled..... | 451,000 | 518,230 |
| Yield per ton..... | 28s. 0d. | 29s. 0d. |
| Cost per ton..... | 18s. 11d. | 17s. 3d. |
| Profit per ton..... | 9s. 1d. | 11s. 9d. |
| Total working profit..... | £205,007 | £303,228 |
| Dividend..... | 25% | 35% |
| Balance unappropriated..... | £66,992 | £111,566 |
| Ore reserve tonnage..... | 1,492,257 | 1,666,000 |
| Assay value per ton..... | 6'83 dwt. | 6'80 dwt. |

Working costs have come down appreciably, and during the last five months of the year were 1s. 2d. below the average for the year. Owing to a decrease in mine-water, from 1,925,000 to 1,375,000 gallons per day, and the completion of pumping-plant for handling this, greater attention could be devoted to development south of the water dike. Sand-filling has been carried on throughout the year, and in addition to rendering worked-out

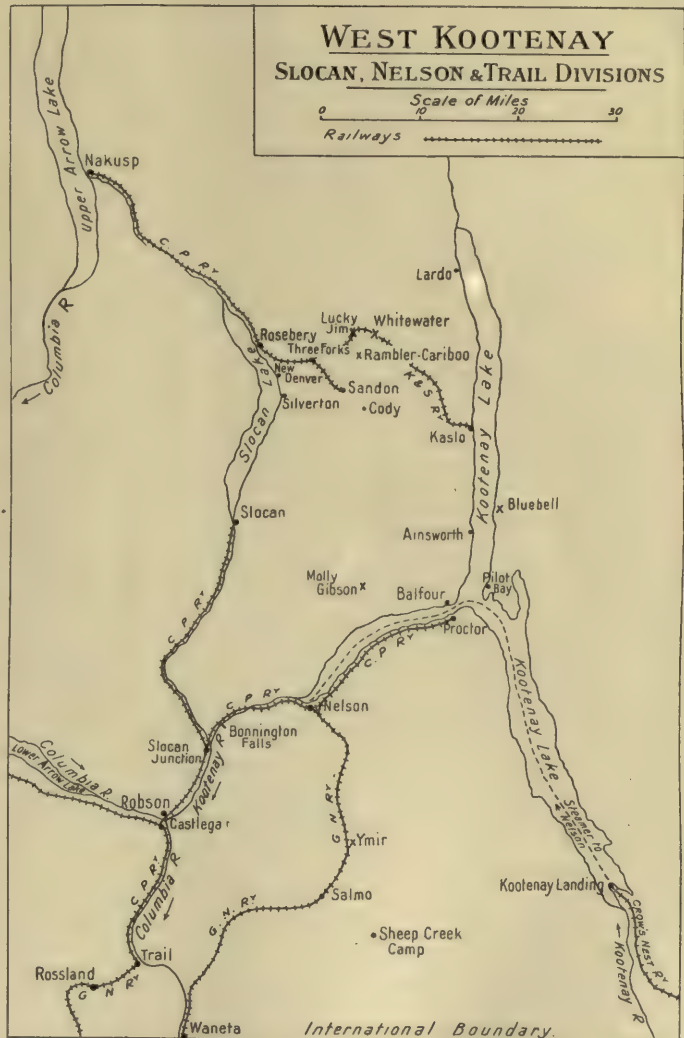
areas safer, has permitted of extensive reclamation of pillars, amounting to 19% of the ore broken. In all 188,781 tons of sand was filled at a cost underground of 4'47d. per ton.

NEW YORK.

British Columbia.—A little known property that has been making good profits is the Standard Silver Lead in the Slocan district. The silver-lead ore occurs in lenticular masses of variable thickness, occurring in zones in the veins. Some of the ore is comparatively clean but a good part of it is mixed with gangue and is sent to the 200-ton mill on Lake Slocan for concentration, where a 60% lead concentrate containing about 75 oz. of silver per ton is made. The zinc concentrate averages 42% zinc and 20 oz. silver. So far all the ore and concentrate has gone to the Trail smelter, but the lowering of the duty on zinc ore in the United States makes it a possibility that the zinc concentrate can be shipped to the zinc smelters in the United States. The company has been doing well and has averaged over \$80,000 a month profit for the last three months.

Speaking of zinc in British Columbia, it is generally known that the Mines Branch of the Canada Department of Mines has been carrying on experimental work at Nelson in regard to electric smelting of zinc ores. The appropriation for this purpose has been exhausted without securing any very conclusive results and the management of the Johnson Electric Smelting Company has lately been taking a keen interest in the situation. Several officers of the company recently visited Nelson and began negotiations for the construction of an experimental plant. The result of this interview was that the Nelson Board of Trade has passed a resolution recommending that the Dominion Government grant an appropriation of \$25,000 to the Johnson Electric Furnace Company when that company shall have completed a ten-ton demonstration plant in the West Kootenay

district, and a second grant of \$25,000 upon the successful commercial demonstration of the operation of the plant by a continuous 30-day run under the oversight and to the satisfaction of a representative of the government. No final decision has yet been made but the provincial government is reported to have expressed a willingness to co-operate in a reasonable way with the demonstration of the elec-



tric smelting of British Columbia lead zinc ores, and the West Kootenay Power & Light Company and the Consolidated Mining & Smelting Company are similarly reported to be favorably disposed towards this new move. The Johnson furnace at Hartford, Conn., has given good results on an experimental run with British Columbia ore, and there seems

to be a very good chance that this new move will prove successful and be the means of rendering available for use great quantities of British Columbia ore which cannot now be handled at a profit.

The Western Federation of Miners, which has been such a disturbing element in the operation of American mines for many years, is apparently facing defeat in its last stronghold. The record of this notorious organization at Cripple Creek and in the Coeur d'Alene is well known to every mining man. A few years ago the organization called a strike at the Homestake mine in South Dakota, and after a protracted struggle it was defeated through the foresight of the management, which urged the better element among its miners to organize a rival union in which the violent men who had controlled the Western Federation should have no part. A little later the Federation called a strike in the copper mines at Bingham (Utah) and Ely (Nevada). Here again the Federation met defeat and the strike was finally called off without the desired recognition of the Western Federation having been obtained. Last year, as everyone knows, the Federation stirred up a strike at the copper mines of the Lake Superior region that lasted for over half a year. Here again the management of the mines was unyielding in its determination not to recognize the Federation, and, all the just demands of the strikers having been granted, this strike also came to an end in the defeat of this anarchistic organization. Meanwhile the Federation was deriving the necessary funds to finance these strikes through assessments paid by the working miners of the Butte district in Montana. Some time ago the mine operators in that district made a treaty with the Federation, whereby none but union miners were to be allowed to work, and also agreed to pay high wages to the miners. The Federation having met defeat in all the other important districts, it was inevitable that the miners at Butte would rebel at being mulcted of their hard-earned wages to furnish the funds for the apostles of violence at the head of the Federation to carry on attacks on other districts, and the unrest culminated a few weeks ago by an outbreak as violent as any that the Federation has instigated, but directed against the Federation itself. The miners refused to pay their assessments and refused to allow their union cards to be examined, as provided in the agreement between the Federation and the companies, to determine whether they had paid. The antagonism

grew until finally the rebels dynamited the hall of the Western Federation and attempted to shoot the leaders of the Federation as they made their escape from Butte. The trouble is not yet settled. The outbreak is a most peculiar one, in that the miners have no grievance against the companies, but are merely rebelling against the union that has exploited them to the disadvantage of mining generally. The outlook for the companies is not a particularly hopeful one, for the revolt has been instigated by the Industrial Workers of the World, an organization that has its chief strength in the eastern United States and is apparently anxious to eliminate the Western Federation as a rival. The leaders of the Industrial Workers of the World, however, preach sabotage and all the other weapons of labour against capital, and the mine-owners are not likely to fare much better in dealing with an organization dominated by this group than it did with the Federation. Mining operations at Butte have been a good deal interrupted by the outbreak and the prospects of greater violence are such that the Governor of the state of Montana has asked that Federal troops be held in readiness.

An English company that conducts steady operations in the United States, but of which comparatively little is heard, is the Ducktown Sulphur, Copper, & Iron Company. J. G. Gordon is chairman and managing director, and C. W. Renwick is manager of the mines at Ducktown, in Tennessee. The company operates a small smelter, which part of the time makes low-grade matte and at intervals re-smelts this to a higher grade. A sulphuric acid plant is operated in connection with the smelter, being the first one of the sort constructed in the United States. The company has recently been experimenting with flotation, but has not yet completed the experimental work. Meanwhile a new company has been formed to operate near-by. This is the Chattanooga Copper Company, which is drilling the 200 acres of land that it owns a few miles northeast of the Ducktown smelter. J. I. Carter is president of the new company, which is made up of Georgia business-men. Mining in Tennessee has shown decided growth lately, for an important zinc district has been developed at Mascot, a short distance east of Knoxville, where the American Zinc Company is now operating a 500-ton mill and has plans for the construction of an additional 1000-ton unit. The ore deposits at this place consist of disseminated blende in limestone; the ore is free of lead, and low in iron.

ROYAL SCHOOL OF MINES

University Agglomeration.—The following letter has been sent to the President of the Board of Education.

Sir—The Royal School of Mines Association (an organization of past students of the Royal School of Mines) is much concerned at the proposals contained in the recent report of the Royal Commission on University Education in London.

This report recommends that the Imperial College of Science and Technology (of which the Royal School of Mines forms part) should be absorbed by the proposed new University of London, and that the control should pass to its senate.

We have every sympathy with the efforts being made to provide London with a great teaching university, and also with the policy to ensure co-operation with the Imperial College, so that there may be co-ordination of the subjects taught and an absence of unnecessary overlap; at the same time, we deprecate handing over control of the College to the senate of the University.

We urge strongly that control of the training in the College and the granting of diplomas be left in the hands of the existing Governing Body, constituted a few years ago under a carefully considered scheme, which provides for representatives of the Crown, of the Board of Education, the University of London, the County Council, the City Guilds, the learned and technical societies, and also of men of affairs acquainted with the technical industries. By duly balancing the representation, it has been sought, and wisely, we think, to ensure that a considerable proportion of the members of the Governing Body shall have had opportunities of becoming acquainted with the professions and industries chiefly concerned in the subjects taught in the College. In the senate of a university, without injustice to the other subjects, this would not be possible. We yield to none in our appreciation of academic culture, but we share the general mistrust of placing a technical institution under the control of a university senate.

Experience in our profession has taught us emphatically that the best results in technical affairs are obtained by utilizing the knowledge of those having had special experience, and we believe the same rule will hold good in technical education.

We believe that the Imperial College, as at

present constituted, is fulfilling its purpose, and is capable of being developed on present lines; any interference at this juncture with this highly successful effort to afford effective scientific and technical training for industrial occupations would, in our opinion, be most regrettable.

The diploma of the Royal School of Mines, indicated by the letters A.R.S.M. (Associate of the Royal School of Mines) is known all over the world. We have reason to think that the substitution of a university degree would be a serious mistake, for the diploma would then cease to carry the significance that now attaches to it, and would no longer be accepted in the mining industry as the hallmark of a special technical training.

WILLIAM FRECHEVILLE, *President.*

EDWARD T. MCCARTHY, *1st Vice-president.*

T. A. RICKARD,

Hon. Sec. and 2nd Vice-president.

Columbia Celebration.—The governors of the Imperial College delegated Mr. T. A. Rickard to represent the Royal School of Mines at the semi-centenary celebration of the School of Mines of Columbia University, held at New York on May 29. The Freiberg Academy, the Ecole des Mines, and the Royal School of Mines were invited to participate in the celebration, which attracted a notable gathering of Columbia graduates. The congratulatory message, engrossed on parchment, suitably illuminated with the arms of the Imperial College, was couched in these terms:

"The Governors of the Imperial College of Science and Technology and of the Royal School of Mines take keen pleasure in accepting the invitation to send a delegate to the 50th anniversary of the founding of the School of Mines of Columbia University, and are glad of the opportunity to tender their hearty felicitations on this auspicious event. They regard with admiration the service done by the Columbia School of Mines in training the men that have taken a prominent part in the development of the mineral resources of the American continent, and they view with fraternal goodwill the powerful influence exerted by the graduates of the Columbia School of Mines in the advancement of the mining and metallurgical professions in America."

These felicitations and the presence of a delegate from the R.S.M. were much appreciated.

METAL MARKETS

COPPER.

Average prices of cash standard copper :

| June 1914 | May 1914 | June 1913 |
|--------------|---------------|--------------|
| £61. 9s. 3d. | £63. 5s. 10d. | £65. 4s. 6d. |

The market has been continuously depressed, not so much by reason of slackening trade as by the ill-advised efforts of the two leading American producers to undersell each other, whereby the consumer is only led to postpone his purchases in hope of some fresh concession. This mistake has been made so often that it has led to regular spasms of buying and of abstention on the part of consumers, who have been taught to withhold their orders until one of the producers gets weary of waiting and gradually cuts the price until the orders are secured. This Dutch-auction method of business is accountable for the short-lived sharp depressions to which we have been so long accustomed. We have had one in June with a drop from £63 for standard at the beginning to £59. 15s. at the end of the month. A recovery is now on the way, as European buyers have been induced to come in substantially at 13½ c. to which electrolytic had been reduced in America. The price is now raised again to 13¾ c. This will probably bring in some of the laggards, who have overstayed their market, for trade in the old world is excellent, with works running at full capacity, while greater activity is announced from America.

TIN.

Average prices of cash standard tin :

| June 1914 | May 1914 | June 1913 |
|----------------|----------------|---------------|
| £138. 16s. 2d. | £150. 19s. 3d. | £204. 9s. 1d. |

The long drop in tin seems at last to have spent itself, and during the last month the tendency, while on the whole downward, has not been altogether in one direction. One prominent manufacturing firm on the continent appears to have invested its reserves in the metal at high prices with serious results, and difficulties have arisen over deliveries tendered in New York. A throe of nervousness overcame the market on the revelation of the position, and the price of cash tin was hammered down to £135. 5s. We have had a £10 recovery from this, following the issue of the June figures, which were unexpectedly favourable. A jump of this extent is probably too quick, and if the improvement is to last it must be steadier. We are, however, past the worst phase. Consumption is on quite a fair

scale, fears of a strike among American tin-platers have proved groundless, and there is less selling pressure from the Straits. It is to be remembered, however, that there is still a considerable tonnage held by stale bulls. Fresh speculation is absent at the moment.

LEAD.

Average prices of soft foreign lead :

| June 1914 | May 1914 | June 1913 |
|----------------|--------------|---------------|
| £18. 13s. 11d. | £18. 4s. 8d. | £19. 10s. 8d. |

Movements in this metal have been puzzling. Supplies were curtailed early in the month by difficulty of freighting from Spain, and by delay in arrival of some Australian steamers. As there was a heavy bear account for May, fancy prices were paid for that and for June delivery. Since then the price slightly decreased, but again became firmer shortly after the close of the month, when the June bears were forced to cover. Some American domestic lead was timed to arrive just when the squeeze was due, and in competition with the regular supplies has been realizing top prices. There is a good market for export, especially in Russia, and more activity among corrodors than for a long time past.

SPELTER.

Average prices of good ordinary brands :

| June 1914 | May 1914 | June 1913 |
|--------------|--------------|----------------|
| £21. 6s. 0d. | £21. 5s. 9d. | £21. 19s. 10d. |

No change in price is to be recorded. There is rather more activity among galvanizers, who have taken orders especially for forward delivery. Some covering has been done in spelter for prompt, but for future delivery they are contented to look on. We shall apparently see no revival in this market before autumn.

OTHER METALS AND MINERALS.

Prices quoted on July 10 :

SILVER.—25¾d. per oz., standard.

PLATINUM.—185s. per oz.

BISMUTH.—7s. 6d. per lb.

ALUMINIUM.—£81 to £83 per ton.

NICKEL.—£170 per ton.

ANTIMONY.—£28 to £29 per ton.

ARSENIC, WHITE.—£13. 2s. 6d. per ton.

QUICKSILVER.—£7 per flask.

MANGANESE ORE.—8½d. to 9½d. per unit.

IRON ORE.—Cumberland hematite 19s. per ton at mine. Spanish 17s. 6d. delivered.

PIG IRON.—Cleveland 51s. 6d. per ton. Hematite 61s. per ton.

WOLFRAM ORE.—30s. per unit (1%).

PERSONAL.

ROBERT ALLEN is again at the Cam & Motor mine, in Rhodesia.

F. W. ARMSTRONG has returned from Nigeria.

H. C. BELLINGER has been retained by the Chile Copper Company, of New York.

A. G. M. BEVAN is home from Liberia, West Africa.

WILLIAM J. CHALMERS, of Chicago, was in London, and is now at Carlsbad.

GEORGE P. CHAPLIN is in British Columbia, for Bruce Marriott & Co.

F. CLOSE has returned from Alaska.

GEORGE E. COLLINS, from Colorado, and HENRY F. COLLINS, from Spain, were in London recently.

H. T. CURTIS is here from El Oro, Mexico.

W. REGINALD DAINY is returning to England from Johannesburg.

LUDWIG H. DIEHL has been honoured by the Prussian government, the title of Professor having been conferred upon him in recognition of his scientific work in advancing and developing the metallurgy of gold and silver ores.

A. B. EMERY, manager of La Fe mine, in Zacatecas, Mexico, is in London.

COLIN FRASER is examining the Laloki mine in Papua for the Mount Morgan Company.

R. J. FRECHEVILLE and WALTER G. PERKINS have returned from the Messina copper mine, in the Transvaal.

W. C. HAND has gone to Russia.

E. M. HAMILTON is home from Salvador.

JAMES HEBBARD, manager of the Broken Hill South mine, is home on leave.

ROSS B. HOFFMANN, KARL F. HOFFMANN and JOHN D. HOFFMANN are in London, with offices at 65 London Wall.

SIR THOMAS HOLLAND sailed on July 1 for Adelaide, to attend the meeting of the British Association in Australia.

EDWARD HOOPER sailed on the *Virginian* on his way to Porcupine.

THEODORE J. HOOVER has returned from Burma.

CHARLES JANIN has gone to California.

SIDNEY JENNINGS is expected in London from New York.

C. D. KEATING succeeds H. C. MEEK as manager of the Dome mine, at Porcupine.

H. I. KEEN has returned from a holiday in Florida.

ERNST LICHTENBERG is making an examination of the Kent coalfield.

LIONEL LINDSAY is home from California.

W. J. LORING, accompanied by Mrs. Loring, will sail by the *Campania* on July 18, on his way to California.

HUGH F. MARRIOTT has been nominated a director of the Cordoba Copper Company.

E. T. MCCARTHY sailed for New York, on his way to Ontario, on July 10.

C. E. MORRIS sailed on July 4 for Australia, on behalf of Arthur L. Pearse & Co.

W. PELLEW-HARVEY sailed for Sydney, on his way to Great Cobar, on July 3.

JAMES ROBERTS has resigned as manager for the Sungei Besi Mines, in Selangor, and is returning to Cornwall.

W. R. RUMBOLD is on his way back to Northern Nigeria.

W. R. RUMBOLD, R. H. JOHNSON, and H. W. LAWS have gone into partnership, with offices at 652 Salisbury House, E.C.

W. S. C. SCRUTTON, manager, and R. E. B. VINICOMBE, assistant to the manager, of the South American Copper Syndicate, are home on leave from Venezuela.

W. E. SIMPSON is home from Mexico.

C. A. SMITH has returned from Mexico City.

E. G. SNEDAKER, of Denver, is on a visit to London.

WALTER G. STANFORD has obtained a certificate by examination as "responsible mine manager" in Russia.

ROBERT C. STICHT has been spending part of his holiday in Montana.

OTTO SUSSMAN, of New York, passed through London on his way to Germany.

A. ERNEST THOMAS is in Portugal.

W. E. THORNE is back from Northern Nigeria.

ARTHUR L. WALKER, professor of metallurgy, left New York on June 16 on a tour to Japan and China.

THOMAS WATTERS is at the Tekka mine, Perak.

MORTON WEBBER is in Nevada.

A. H. WILLIAMS has left for Northern Nigeria.

ERNEST WILLIAMS has returned from Paramaribo.

S. EARDLEY WILMOT has returned from Burma.

CHARLES W. WRIGHT, manager for the Societa di Pertusola, is examining Lord Brassey's iron-ore lands in Northern Michigan.

POPE YEATMAN was in London for a few days early in June.



DISCUSSION

Cornish Methods.

The Editor :

Sir—Are the processes of tin-recovery in the Cornish mines so defective and so easily improvable as many rather ill informed people have assumed of late? When a workable chemical method of extraction has been devised we may allow perhaps that such is the case. But while we have nothing better than mechanical methods to rely on I do not think that much improvement is to be looked for. It is certain that part of the tin, in some mines a considerable part, exists in a state which cannot be mechanically recovered to advantage; for instance, particles of stannite left in the concentrate would seriously lower its value while increasing the tin contents as determined by chemical assay. They must therefore be removed in dressing.

J. H. COLLINS.

Crinnis, June 24.

Origin of Diamonds.

The Editor :

Sir—I notice in your issue for June an article on this subject that particularly refers to a paper read by Mr. Gardner F. Williams at a meeting of the Canadian Mining Institute.

From his long experience as general manager of the Kimberley diamond mines his opinion on this subject should have great weight, because for many years he had opportunities of studying the unique formation in which the diamonds are found, and the varying characteristics of these gems.

In April 1878, when I had completed my report on the coalfields of Cape Colony for that government, I secured a seat in the post-cart (for there were then no railways) and by continuous travelling, with a few adventures *en route*, I arrived at Kimberley in eight days. I stayed one month in order to study this remarkable deposit. The Kimberley mine was then being worked as a quarry and the central workings were only 240 ft. from the surface; and on returning home, I read an exhaustive paper on the 'Kimberley Diamond Mine' be-

fore the Midland Institute, at Birmingham, printed in the Transactions of the South Staffordshire and East Worcestershire Institute of Mining Engineers, Vol. 4, from which the following are extracts :

"Each of the mines at or near the town of Kimberley have distinctly defined boundaries of 'reef,' and within this limit is contained the diamondiferous earth containing in its matrix most capriciously and irregularly placed, and yet with a very great degree of certainty, diamonds varying in size and colour. Beyond these boundaries of 'reef,' which is nothing more or less than stratified shale, quite natural and regular, and containing no diamonds whatever, they may be, and often have been found on the surface some distance from the diamondiferous earth, but all these may be called 'rolling stones,' for they have certainly been drifted from their original matrix and site during the period when these plains were subjected to denudation; but beneath the surface and in the stratified shale of which the surrounding country is composed, no diamonds occur. Why is this? Why do these small areas—for we have seen that the Kimberley mine only contains nine acres—contain such rich deposits to whatever depth they have been excavated, and yet the ground outside never contains a single diamond? This ground has been pierced on every side of the mine, either by wells or shafts, and yet no trace of diamonds has ever been seen. The answer appears to be simply this. The diamond mines near Kimberley and certainly this one bearing that name, *exist only in the craters of extinct volcanoes, which were probably subaqueous* when in an active state, and finally became filled with a semi-liquid material, containing detached pieces of fallen shale from the sides of the crater, much decomposed lava, together with the diamonds, which would seem to have been injected into it from depths too profound to calculate with the slightest chance of accuracy.

"At Kimberley they are concentrated in a matrix chiefly composed of volcanic products in an oval area of nine acres, the boundary of which, to a depth of 240 ft., is proved to be stratified shale lying nearly horizontal, and the sides of the mine are so nearly vertical that the area is only slightly reduced now the excavation has attained its present depth. Such places as these appear to be very near nature's laboratory for these precious stones, and probably it is under such peculiar circumstances that all diamonds originated, and from these sources of supply denudation distributed them over large areas, and the natural order of events would ultimately place them most plentifully in the banks or beds of rivers.

"While the diamondiferous earth or matrix was in a semi-liquid state, there must have been ebullition, which appears to have distributed the diamonds irregularly throughout the mass. It has been noticed that they are most abundant at the sides of the crater or beneath boulders or masses of 'floating reef,' as though they had had an affinity for such places, and had been governed by a law, something akin to the one that causes the air bubbles on the surface of any liquid sooner or later to find their way to the side, and it is noticed too that they increase in number as the mine becomes deeper. Another peculiarity of this distribution is that different parts of this mine have produced, and continue to produce, diamonds of a special colour or shape. For instance, all the west end is noted for the fine, glassy, transparent, octahedron stones, while at the east end several claims have been always noted for large yellow stones. And it is also an established fact that each of the four mines already named, although within so small an area, produce stones so peculiar to each mine that an experienced broker or buyer will recognize at once the produce of each mine, and tell the digger from which he has brought them. These circumstances are very peculiar and more easily noticed than accounted for, and will afford material for conjecture, and for speculative theories for some time to come. The writer does not attempt to explain the cause of these clearly apparent facts, nor to speculate upon the formation of the diamonds which have been so concentrated upon this favoured spot, *but he does venture to affirm his conviction that they came from below*, and in consequence he assumes that there is every probability that greater depths will be at-

tained than the most sanguine have conceived, and that a greater proportion of large ones will occur than in any ground yet excavated. Actual work and past experience would seem to support this view, for there is no doubt that the ground is much richer now than it was at the surface, and although the depth of the whole mine averages 200 ft., the value per load of the diamondiferous earth is greater there than it has ever been."

At this early date in the history of the mine, I formed a very decided opinion that the matrix in which the diamonds are found, now known as 'kimberlite,' was of aqueous origin, and therefore in my opinion Mr. Gardner F. Williams is quite right in the decision he has now arrived at after mature consideration, "that the blue ground was introduced into the pipes from below by aqueous rather than igneous action in a manner characteristic of the mud volcano."

FREDERIC WILLIAM NORTH.

London, June 24.

Ore.

The Editor:

Sir—I admire your efforts to arrive at a satisfactory definition of the term 'ore,' and I think your recent amended form is in all ways excellent, yet it seems to require a preliminary definition of the term 'metal-bearing.' Aluminium is a well known metal, but do you mean to class china-clay or bauxite with the ores? Sodium is a metal, but is rock-salt an ore? Many other such instances will at once occur to you and your readers. We have the terms 'precious metals' and 'base metals' in common use; how are we to characterize aluminium, etc., in this connection? And what about sulphur, arsenic and the like?

The fact is that the terms metal-bearing and metalliferous date from times anterior to Davy's discovery of the metallic basis of soda and potash.

Pray give us your views on this subject.

J. H. COLLINS.

Crinnis, June 24.

[Bauxite is an ore of aluminium; china-clay is not. Rock-salt is not an ore of sodium, but pyrite is an ore of sulphur. 'Metal-yielding' might be better than 'metal-bearing.'—EDITOR.]

The Editor:

Sir—Referring to this discussion, I think your definition contains the keynote of the term, when it makes "profit" the qualifying factor.

In examinations of prospects and non-working or partly developed mines, it is impossible in many cases to say whether profit would be produced from the operations or not. Some term must of necessity be employed.

I suggest as a suitable definition of ore when applied to metalliferous mines or deposits:

"Ore is that material from which it is intended to produce profit." I assume, of course, that the person intending to perform the operation is properly qualified.

D'ARCY WEATHERBE.

London, June 20.

[A technical definition that involves the idea of motive is impracticable. Hell is paved with ore answering this description. The intention to win profit is assumed in business.—EDITOR.]

The Editor:

Sir—Having read with interest much of the correspondence in this magazine on the above subject, including your excellent summary and final definition as given in the April number, I join with many of your readers in expressing appreciation of the good work done by ventilating differences of opinion as to the exact meaning of this innocent-looking little word.

My feeling is that while your concise definition ("Ore is metal-bearing rock that can be exploited to economic advantage") is excellent, as far as it goes, nevertheless, perhaps a little more allowance should be made for use and custom. For this reason dependence on *present* profit or *present* economic advantage might be enlarged a shade, so as to include much of the meaning still given to the word 'ore' by several of your correspondents. With this object in view, I would suggest that your last definition be slightly enlarged to read as follows:

"Ore is a metal-bearing substance which can be, has recently been, or probably may be in the near future worked* to economic advantage."

This definition would allow such statements as the following:

(1) This copper ore cannot now be worked at a profit since the price of the metal has recently decreased to such an extent. We hope, however, that by improving the methods of mining and introducing a new metallurgical process, we shall soon be able to work the ore at a greater profit than ever before.

* I prefer this good English word to 'exploited,' which seems unnecessarily foreign.

(2) The nickel and copper contents of the pyrrhotite deposit increase in the direction of the dip, so that while the (mineral) deposit cannot be said to contain any profitable ore for the first 100 ft. from the outcrop, nevertheless, from that distance to the farthest points yet explored, the existence of a valuable ore-body has been proved.

In the first case the word 'ore' is conveniently used for a mineral substance which at the moment cannot be worked at a profit, but which there is good reason to believe can soon be worked at an even greater profit than formerly. In a case like this, it does not seem to me worth while to drop the word 'ore' and substitute another term which would probably only be used for a few weeks or months.

In the second statement, the first 100 ft. of the pyrrhotite deposit would not be rightly described as an orebody, but only as a nickel and copper-bearing pyrrhotite deposit.

Your definition as it stands, or slightly enlarged, as I suggest, would seem to answer all practical requirements, and still avoid ambiguity. I hope that such a definition will be accepted universally by the mining community. In any case, we owe you a debt of gratitude for the lead you have given in preventing the misuse of this simple little word.

C. BRACKENBURY.

Newton Abbot, June 27.

[In saying that it "can be" exploited to economic advantage, we look both backward and forward, to the past and future.—EDITOR.]

New Kleinfontein.

The Editor:

Sir—I shall esteem it a favour if you will correct a statement on page 390 of your excellent issue for May, under heading of 'New Kleinfontein.'

You state: "Edward J. Way, until recently the consulting engineer, and an old opponent of tube-mills, did not install any until 1913."

Please note that I am still consulting engineer to the New Kleinfontein company, and that I am not an opponent of tube-mills. Careful research with the ore at Kleinfontein showed that it gave up its gold in a remarkable manner without very fine grinding, and I need hardly say there is an economic limit to fine grinding. It became, however, necessary to increase the capacity of the old plant, which was originally designed to treat 28,000 tons per month. Twenty stamps were added to the original 200-stamp mill, and the capacity

was increased to 35,000 tons per month. Finally, in 1912, four tube-mills and other plant were added, increasing the capacity to 52,000 tons per month. The reason that tube-mills were added was that owing to the geographical position and arrangements of the mill, and to the arrangements between the sorting-house and the stamp-battery, it would not have been advisable to erect more stamps. Operating costs are higher as far as reduction is concerned, and the results as stated in my report for 1913 are as follows: "With regard to capacity, the plant has come up to expectations, but the extraction results are about the same as they were last year, namely, 94.66%, as compared with 94.6% in 1912 and 95.79% in 1911." In 1911 there were no tube-mills in the plant. It is erroneous and misleading to state that I am an opponent of tube-mills, and I have installed tube-mills in other plants where the metallurgical conditions showed that they would be economically useful.

EDWARD J. WAY.

Johannesburg, June 17.

The Radium Hunters.

The Editor:

Sir—As you have kindly invited me to answer in your magazine the attacks made upon me in your article called 'The Radium Hunters,' I propose going over it as briefly as possible.

With regard to the following observations in the first part of your article: "The association of radium with uranium minerals is a fact, but all uranium compounds do not contain radium, and when they do contain it the proportion is subject to no law as yet discovered," you can only mean uranium mineral compounds because it was mineral compounds and no other that were under consideration. As you are now doubtless aware you differ from all the experts on this subject. Professor Rutherford, our greatest English authority, writes: "Known the percentage of uranium in a given mineral, the amount of radium can be at once deduced without measurement."

The question is how was it possible for me to know you differed from all other experts and were going to criticize my report and figures in a new law, which I had never even heard of and which completely upsets all the work and calculations done by Madame Curie, Professors Rutherford, Boltwood, and others.

Then you go on to state "Moreover when radium is finally extracted, there is no ready

sale for it." That I can assure you is a mistake; we have no difficulty in selling all we can make and I guarantee to sell for you 2 or 3 grammes of pure radium bromide within a month. If you don't believe me try and buy some radium. You then go on: "However, it appears to be admirably adapted to a pseudo-scientific exploitation of old mines and new simpletons, as is illustrated by the South Terras flotation." Now, I suppose you will not deny that the exploitation referred to can only mean you consider that the mine is valueless; if you did not mean that, what did you mean? You evidently had before you the report on the South Terras mine signed by Madame Curie, otherwise you would not have written "Madame Curie is most unfortunate in having her name dragged into the South Terras flotation."

Now I ask, why was she unfortunate? She sent her Preparateur Professor Danysz to sample the ore at the mine, she herself made the assays or determinations of values. For this I happen to know she received a large fee in cash, and the treatment of the bulk of the ore at Gif, in France, has confirmed the accuracy of her work and has only reflected credit on the sampler and assayer.

I know a good many professional men who would like to experience a similar misfortune. I must confess it is a complete puzzle to me how you arrived at the conclusion that the South Terras mine was valueless and therefore practically a swindle. Besides Madame Curie's report you had before you the reports of J. & G. Danne, who are two of the best known experts on radium. You evidently did not believe them when they stated that after careful investigations extending over two months, there was about 10 grammes of radium in the ore at the surface, representing a value of about £200,000.

The mine was sold by public auction in 1911 for £3100 and bought in by the mortgagees and re-sold by them for a profit of £10,000. The fact is that far from the South Terras mine being valueless, a large sum has already been recovered, and the ore is being so successfully treated at Gif that it has been found necessary to erect a further unit of plant to meet the demand we have for our radium. This unit will be shortly at work. Arrangements are in progress to have the mine pumped and then when ore is being treated from the mine even better results are anticipated, because when it was pumped for inspection, in February 1913, there was found to exist a large body of ore which had a higher average value than the ore on the surface.

The next thing you say is "In any case the report made by Mr. Fawns like that made by Mr. James Thame is not in accord with the standards of the profession." I would like to know what standards you mean.

You then go on: "at the time of inspection the mine was full of water and therefore the examination was a farce." This can only mean that therefore the examination of the mine was a farce. This is clearly an unfair statement, because I was most careful to state that the mine being full of water at the time of my visit, "I based my report on the plans of the mine, the returns of the ore sold, the evidence of the country rocks on the dump, and the information supplied to me by Mr. John Brenton, the late manager." I might have added also "on several good and authentic accounts of this mine by eminent mining engineers."

You go on to state that "Mr. Fawns quotes samples assayed by Mr. Benedict Kitto, who is in no way to blame, but Mr. Fawns does not say whence these samples came." You evidently did not read the reports; there never was more than one set of samples, and it is twice certified by Mr. Thame that these samples came from the South Terras mine and were obtained by him, and, I might have added, in my presence. Having stated this fact twice under the assay-certificate, I did not think it necessary to repeat the same in my report. Please remember the assay-certificate and my report were issued together, and never one without the other. Therefore the question I ask is, why you made the statement that I did not say where they came from.

You further state that I arrive at my conclusions "on a flimsy basis, he proceeds piling one assumption on the top of another until he finally forecasts an output worth £5000 per week. The question of cost is dismissed summarily without any estimate being given." I thought I had gone fairly fully in my report on what I based my figures. It is quite true it would have been easy and perhaps better for me to have given much fuller details; it would take too long to do so here, but I am quite willing to prove before any body of mining engineers that it was anything but a flimsy basis on which I based my figures. It was in reality a carefully considered opinion and one which is being proved to be a correct forecast by actual working results.

The question as to the cost of treating the ore from the South Terras mine was at the time of my report an impossibility for any one to estimate, as a new process had to be evolved.

You blame me for not giving an estimate; why even now it is impossible, and will be until the full plant is at work in September.

You apply rather hard remarks to my report when you state "It is not too much to say that this report by a member of the Institution of Mining and Metallurgy constitutes a scandal." Of course if I had done what you inferred, reported on a mine without stating it was full of water and without giving proper data upon which the report was based, as several people told me they thought I had done after reading your article, you might then have been justified, but are you justified in stating my report constitutes a scandal, when all the facts are carefully considered?

I claim no attribute of infallibility; I simply gave in my report an honest opinion of the value of the South Terras mine. I am certain by the practical results obtained that I have not been unduly optimistic. I was not in any way responsible for the finance of the mine or the amount of the nominal capital. It is unfortunately true your criticism has caused me a great deal of personal worry and a certain amount of pecuniary loss, but as I hope this was not your object in writing your article, perhaps you would be glad to do what you now can to remedy the damage which I have unjustly suffered.

Today the South Terras mine may be under a cloud chiefly owing to bad finance, but the day will soon come when my figures and forecast as to values will be exceeded by results. It is certain from records I have been to great trouble to obtain that this mine has produced more uranium ore, hence radium, than any other in the world, and it is far from being exhausted. It is an interesting fact that it is the only lode that has been worked for uranium and for nothing else.

SYDNEY FAWNS.

London, July 6.

[The foregoing letter should have been sent 16 months ago. It is our consistent policy to allow anybody criticized the opportunity to state his side of the case. Mr. Fawns was told more than a year ago that a rebuttal from him would be given space, without demur. It is our regret, and in no way our intention, to cause personal injury while in the exercise of our functions as a critic of mining affairs. Mr. Fawns's reply is written in a reasonable spirit; we do not desire to prolong the controversy by reply. We have had our say, and we are content to let him have his.—EDITOR.]

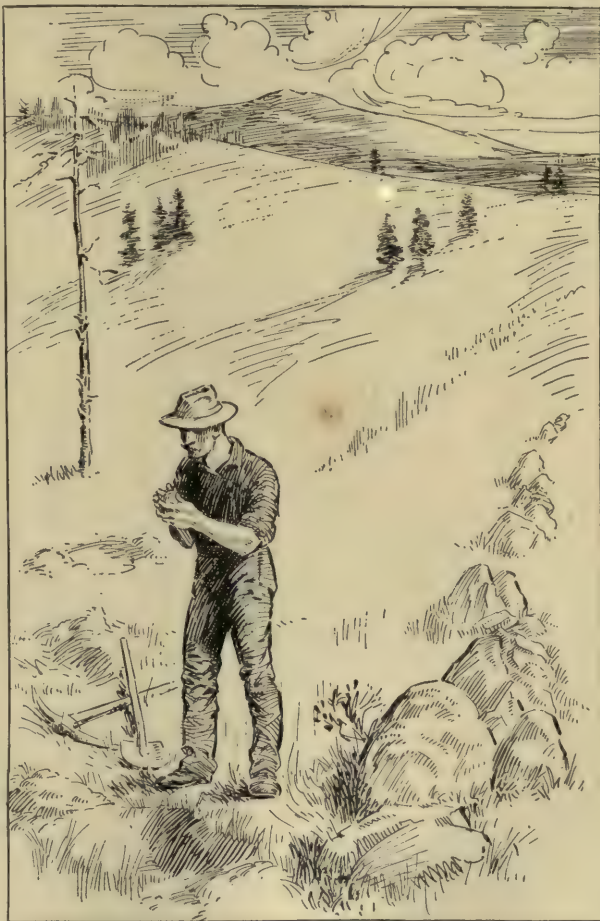
GEOLOGY APPLIED TO MINING. II.

Fortuitous Discoveries. Aid of Mineralogy. Elementary Geology. Colorado. Nova Scotia. Bendigo.

By T. A. RICKARD.

*WHILE geology is one of the sciences applied to the art of mining, I am compelled to admit that the positive applications of geology to mining are not always obvious. The first rule in mining is to find ore, and the second is to follow it. The finding is often done by men unversed in written knowledge and ignorant of rock history. If we take gold mining as an illustration, we shall ascertain that the detection of particles of gold in the gravel lying in, or adjacent to, the running stream has usually afforded the first clue to intelligent search for ore in place. James W. Marshall, who was the pioneer of the golden age of California, was, as you know, a carpenter, who, in deepening the tail-race of a saw-mill at Coloma, detected the presence of small nuggets of gold. He boiled them, and proved them insoluble in water; he hammered them, and ascertained that they were ductile; but it cannot be said that this historic event of January 24, 1848, was the consequence of applied science.¹ The finding of gold in Australia may be said to have been less fortuitous, for E. H. Hargraves, having previously had some experience of mining in California, was led, by the analogy of geologic conditions, to look for gold in New South Wales. Soon after his return to Australia he was able, on April 3, 1851, to inform the Colonial Secretary that gold existed in the gravel at "Lewis Ponds and Summer Hill creek, and the Macquarie river, in the districts of Bathurst and Wellington."² He was placed in communication with the Government Geologist, to whom he gave ample proof of his statement. That marked the beginning of gold mining in Australia.

When detrital gold is found in the alluvium of the valley, it is usual to search for its source in the lodes that outcrop on the neighbouring hillside. The relation of placer-gold



THE DISCOVERY OF THE INDEPENDENCE MINE, COLORADO.

to vein-gold is now one of the axioms of mining, but even an inference apparently so obvious came empirically rather than by scientific reasoning. In many now celebrated gold-mining districts no attempt was made at first even to test the outcrops of quartz plainly visible to the diggers in the gulch. When the shallow placers had become nearly exhausted

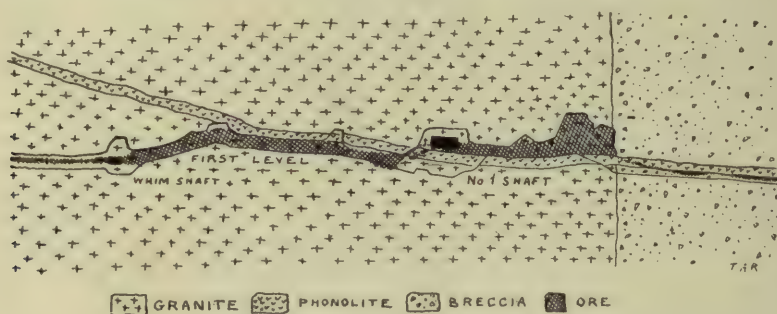
* The second of a series of five lectures delivered at Harvard University in May 1913, and at the Royal School of Mines in January 1914.

¹ 'Through Alaska and the Yukon.' By T. A. Rickard. Pp. 114-118.

² 'The Mineral Resources of New South Wales.' By Edward F. Pittman. 1901. Page 4.

or had been fully covered by claims, the miners attacked the soft outcrops with the pick and shovel, washing the shattered rock into their sluice-boxes, after the manner they had learned on the placer. In some districts, such as Silver Plume, in Colorado, the outcrops consisted of soft gossan, resulting from the weathering of gold-bearing pyrite in mica-schist, together with a minimum of quartz. Such were the Griffith vein at Empire and the Whale vein at Idaho Springs when first discovered in 1859 and 1861.* These deposits were amenable to sluicing. They served as a link between the placer and the lode; they gave even the inexperienced prospector a clue to the source of the stream-gold; they led him to the digging of holes in the hard rock and the pursuit of ore under the surface.

to be seen on the south slope of Battle mountain. All the early prospectors passed it by, without even chipping it with their hammers. One of them, W. S. Stratton, who was a prospector only when not occupied in his trade as a millwright, had found free gold in the detritus of frost-shattered rock that covered the hillside. He panned the 'dirt' and hoped that it might lead him to a vein. When the débris became poorer instead of richer he knew that he must have advanced above its source, yet he could not see any signs of a vein, although a magnificent outcrop stared him in the face. "That," he said to himself, "Oh, that is only rotten [decomposed] granite; that is no vein."¹ He did not trouble to test it, for he knew, or thought he knew, that the gold must be derived from a quartz vein.



THE INDEPENDENCE VEIN AT 1ST LEVEL SOUTH.

After he had begun to exploit the vein of ore, the miner was still slow to apply even the rudimentary principles of geology. He accepted the aid of mineralogy first. In gold mining he noted the fact that quartz was the usual associate of the precious metal, hence he assumed that gold was only to be found in such association. Lode mining for gold became known as 'quartz' mining. This was the case both in California and Australia. In Colorado also the association of gold with quartz was so general that the prospector looked for detrital quartz or 'float' to guide him to the veins, and if such indications were wanting he confessed himself at a loss. As late as 1891 the richest outcrop of ore in the Cripple Creek district was overlooked for this very reason. Gold had been found in a gulch, and some of it had been traced to veins in the surrounding hills, but outcrops were scarce and the search for ore was made largely by means of haphazard trenching. The one prominent outcrop in the whole district was

Incidentally, I may remark to you that the first step in science is to separate what we know from what we don't know. Finally, when about to move his tent and search elsewhere, Stratton took some pieces of the shattered 'porphyry' with him to be assayed at Colorado Springs, where his home was, and at the same time he chipped a piece off the granitic outcrop. That sample assayed 19 ounces of gold per ton! He returned next day—July 4, 1891—and located the 'Independence' and 'Fourth of July' claims. The granitic outcrop was the Independence vein, one of several veins in the Independence mine, which made Stratton a multi-millionaire. It has yielded \$21,000,000 in gold and \$10,000,000 in profit.

While quartz is so often the matrix of gold, other minerals are likely to be more indicative.² A rough sort of mineralogy is the first

* 'The Development of Colorado's Mining Industry.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXVI., page 837.

¹ As related by Stratton to me. See also 'How the Independence Mine was discovered.' By T. A. Rickard. *Engineering and Mining Journal*, July 15, 1899.

² 'The Minerals which accompany Gold, and their Bearing upon the Richness of Ore Deposits.' By T. A. Rickard. Trans. Inst. Min. & Met. Vol. VI., Pp. 194-214.



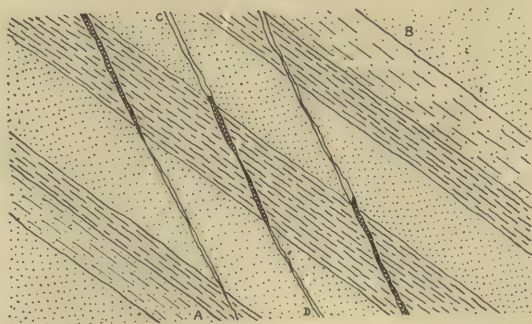
THE CALIFORNIA VEIN, COLORADO.

accomplishment of an intelligent miner. It may be 'mundic,' or pyrite, it may be 'grey copper,' or tetrahedrite, it may be 'black jack,' or sphalerite, that gives him a clue to the richness of his vein long before he has made a test either by panning or assaying. Again, he may be able to make closer distinctions, ascertaining by experience that the fine-grained pyrite is more favourable than the coarsely crystalline, that yellow zinc-blende is a better sign than the black, or that the excess of a particular mineral tends to negative its usually enriching effect. But these indications have only local significance. If applied indiscriminately, they prove misleading. At Cripple Creek, for example, pink fluorite is the common associate of the tellurides of gold and silver. When, therefore, Thomas F. Walsh went from that district to the San Juan region, also in Colorado, he had learned to regard fluorite as the miner's friend, in so far as it served as a guide to profitable ore. When subsequently he saw some pieces of pink

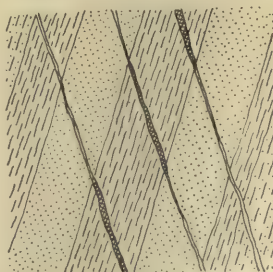
spar on a dump in Imogene basin he decided not only that it was fluorite but that it was evidence worthy of his attention.* He sampled the vein that he found in the abandoned workings from which the pink spar had been derived; much to his surprise, and subsequent gain, he ascertained that it assayed several ounces in gold. The pink spar was not fluorite; it was rhodonite. However, it led Walsh to uncover the orebodies of the Camp Bird mine, which subsequently yielded \$22,785,500 gross, and \$11,400,000 in profit.

In this case an error led to an important discovery. The example goes to prove that a careful assay is better than a careless inference. Only when other evidence is lacking is an engineer or a geologist warranted in making a rough-and-ready guess. For instance, in the southwest [of the United States] generally, and in Arizona particularly, the appearance of zinc-blende in a precious-metal lode has often proved to be a premonition of impoverishment in depth, just as the detection of traces of chalcocite in an oxidized copper vein may justify the expectation of penetrating shortly into a zone of secondary enrichment. Thus, in given districts, it may hap-

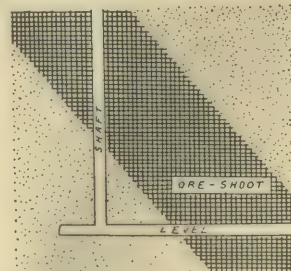
* 'Two Famous Gold Mines.' By T. A. Rickard. *Mining and Scientific Press*. December 16 and December 30, 1911.



PLAN



SECTION A-B



SECTION C-D

SLATE / ORE SANDSTONE

ORE-SHOOTS COINCIDING WITH VEIN CROSSING FAVOURABLE BED, SHOULDN'T WONDER MINE, VICTORIA.

pen that a specific mineral will afford guidance, but it is a guidance that must be accepted hesitatingly, and tested frequently. After all, the actual presence of gold is the best sign of gold ore, and frequent assays are more reliable than supposed mineralogical associations based upon an experience that at its best is limited to a small part of the earth's surface.

As I have said, the aid of mineralogy comes more readily to the miner than that of geology. In some districts the positive application of geology is not immediately practicable. The intelligent development of a mine may, and usually does, benefit from a general knowledge of the local rock-structure, but that knowledge, as a rule, does not come until the mine itself has extensive workings or until the district in which it is situated is nearly worked-out. Like the experience of life, such enlightenment often comes too late. The scientific investigations of some celebrated mining districts have proved to be post-mortems, and some elaborate geological reports have been no better than delicately worded obituaries. Not that obituaries, whether of men or mines, are devoid of instruction and human interest: they may be rich in both; but they partake of the posthumous, they benefit only those who have become detached from the events and developments therein recorded. The test of science is not to write last year's almanac, but next year's. To foretell what will happen under given conditions: *that* is the justification of science. Thus, when a mine is in its infancy, the owner may lack the guidance that becomes plentiful when it is exhausted. Hence he must be acutely observant from the start and apply the result of his observations as he proceeds with his work, as a wise man utilizes his experience of life while he is still young. Live and learn. Learn while you live. That is a motto that applies in mining as in life generally.

As I have already suggested, the application of geology may either be deferred for a while or it may not be practicable at any time, to a notable degree, particularly in districts having no clean-cut geological structure. Thus, for example, in Gilpin county, Colorado, where I first served my apprenticeship, the veins are in granitoid gneiss of pre-Cambrian or Algonkian age. Being part of a crystalline complex of great geologic antiquity, the stratification has been obscured by metamorphism. It is true, the distribution of rich ore is affected by dikes and other intrusions of andesite, probably of Tertiary age, but the influence of this younger intrusive rock is not obvious to

the mine superintendent, who depends mainly upon the assays of the lode-matter to indicate in which direction to advance his workings. In short, it is to the assayer, rather than to the geologist, that the miner turns under these conditions. That was my first impression as a student recently graduated from a school of mines. Yet some signs were not lacking to a patient observer. The porphyritic quartz-andesite or 'dacite' had evidently played a part in the enrichment of the rock along the lines of fracture that constituted the veins. At one place, several acres in extent, called The Patch, the andesite had intruded into a shattered mass of granitoid-gneiss, making a large area of low-grade ore at surface and a reticulation of rich veins underground to a depth of 700 or 800 feet. The most persistent lode discovered in this district, namely, the California vein, is associated with a dike 17 feet thick, diverging from the dike at 300 feet below the surface but lying next to it throughout the major part of the workings to 2200 feet. Even where the veins are not close to dikes, it is probable that they were enriched by thermal waters circulating along fractures formed at the time when orogenic movements forced the eruptive material to the surface. Most of the veins cut across the foliation of the country-rock; when they follow the folia they are usually barren of ore.¹ Intersections of veins are favourable to orebodies. Wet ground is a good sign, presumably because such ground is not closed now to enriching solutions, nor was closed to such solutions during the ore-forming period. Both walls of a vein in this district are rarely well defined; when andesite is on one side, the mineralization appears to spend itself most freely on the eruptive and more soluble rock.² The veins follow fractures that mark dislocations of the country-rock, but the extent of the faulting is rarely measurable owing to the absence of datum points in the schistose granite. All these observations, while not lacking in academic interest, are scarcely such as would direct the average superintendent where to find ore. Such a man in this district finds it more profitable to make frequent assays, to study the survey of the workings, to look out for branch veins or slips that may lead to subordinate orebodies, and to take great pains to keep on the track of ore once he has cut it in a drift, a cross-cut, or a stope. The immediate assistance that the geologist can offer is

¹ 'Notes on the Vein-Formation of Gilpin County.' By Forbes Rickard. Trans. A.I.M.E. Vol XXVIII. Pp. 108-126.

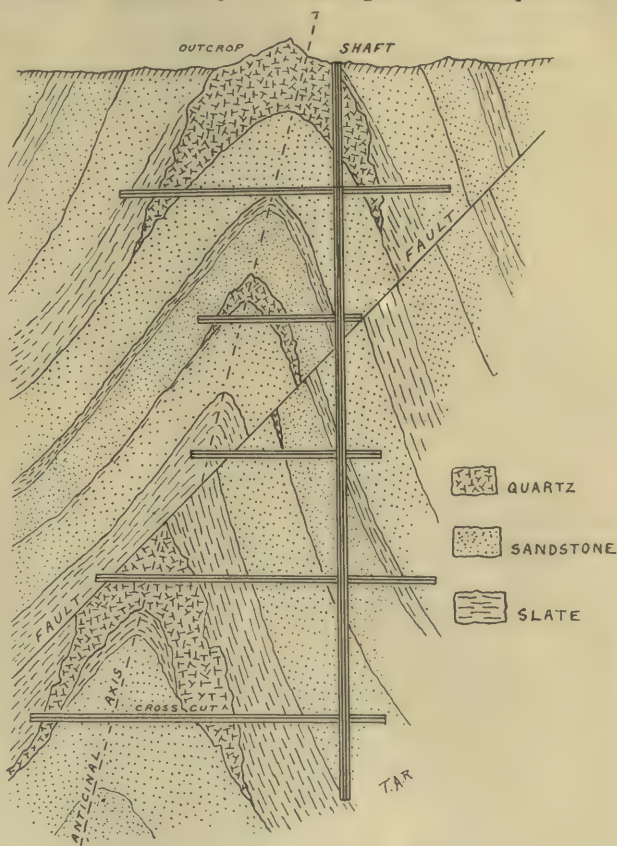
² 'Vein-Walls.' By T. A. Rickard. Trans. A.I.M.E. Vol. XXVI. Pp. 193-241.

apparently of slight value, yet a knowledge both of mineralogy and geology cannot fail, even under such discouraging conditions, to give point and intelligence to the observation of any man underground, whether he be shift-boss or consulting engineer.

Among the inferences from local experience in this district of Gilpin was the supposed existence of a pyritic zone, or 'cap,' as it was called, that was thought to affect the vertical distribution of the precious metals in the veins. Down to about 150 feet these veins were oxidized; below that the mine workings penetrated pyritic ore, yielding a scanty profit. As operations became more profitable a couple of hundred feet deeper still, the miners said there was a 'cap.' When the workings reached this horizon, the prosperity of the owners was checked, and, as many of the mines reached the unfavourable zone at about the same time, this circumstance had a depressing effect on the district as a whole. It is likely that the conditions observed in this case were misconstrued. Apart from such enrichment as is common in the superficial portion of gold veins, the oxidized condition involved the liberation of the gold from its pyritic envelope, rendering it 'free milling' or docile to simple amalgamation. The veins were not more impregnated with pyrite from 150 to 350 feet in depth than below that fictitious zone, but the sudden change from an oxidized and docile ore into a sulphide and relatively refractory ore created a metallurgical difficulty, even where the gold contents remained the same. Moreover, at the base of the oxidized ore the by-products of oxidation, such as sulphates, which are peculiarly inimical to successful amalgamation, caused troubles from which the mill-men were free a couple of hundred feet deeper. In consequence, the yield declined for a time, coincident with the early penetration of the workings into sulphide ore, but it improved later, and deeper, for reasons that were metallurgical rather than geological. This was an example of empiricism or rule-of-thumb, but it was the result of observation, and such observation, when subjected to careful analysis, leads to true induction, which is the basis of science.

Intelligent observation will lead to a detection of the trend, or 'pitch,' of orebodies, an

item of information in itself most important to the profitable operation of a mine. Here we have an effective example of the economic application of science. The simplest illustration, within my knowledge, of the relationship between the pitch of the orebody (as distinguished from the dip and strike of the lode) and the structure of the enclosing rock is afforded by the small gold veins exploited in



THE SADDLE-REEFS OF BENDIGO.

the Australian Alps, in the Ovens district, Victoria. The country consists of beds of slate and sandstone of Upper Silurian age. The bedding is easily distinguishable. At the Shouldn't Wonder mine, for example, the dip is west 79° , and the strike 55° west of north. The gold-bearing quartz vein traversing the sedimentary rocks in this mine has a strike 28° west of north and a dip eastward of 76° . Thus the vein crosses the stratification almost at right angles on the dip and at a small angle on the strike. The vein of quartz is from 15 to 24 inches wide. An examination of the stopes shows clearly that the line of intersection between the bedding-plane of the rock

and the wall of the vein slopes at an angle of 45° south. This is marked on the foot-wall, where the alternating beds of slate and sandstone are clearly distinguishable. The angle of intersection, namely, 45°, coincides with the pitch of the orebodies as worked on four successive levels.¹ Thus the manager has a valuable guide in the systematic development of his mine and is afforded a clue in his search for further ore, it being a logical deduction that the deposition of ore has been affected by certain favourable beds of slate—not sandstone, in this case, nor usually in Australia. Apparently the slate contains something, probably carbonaceous matter derived from vegetal remains buried in the original silt, that acted as a precipitant for the gold in the ore-forming solutions. However that may be, the fact, which is more important to the miner, is that the pitch of the orebodies coincides with the intersection between the vein and sundry beds of slate, making short orebodies sufficiently rich to yield dividends. The same vein is enriched where it crosses successive beds of slate. This will be rendered clear by a diagrammatic representation² of the structure. The beds of sandstone and slate are shown, first in plan, then in section across the plane of the country-rock, and then in section along the foot-wall of the vein.

At a later date I found another important example of the relation between the pitch of orebodies and the structural lines of the country-rock. In 1896, when I had the honour of acting as assistant to Rossiter W. Raymond in an examination of the celebrated Drumlummon mine, in Montana, we concluded that the orebodies coincided in their pitch with the intersection between the plane of the vein and that of the cleavage in the enclosing slate. A third example was detected by me in Nova Scotia,³ when examining the goldfields of that Province for the Government in 1905. There the pitch of the bonanzas or local enrichments in the quartz veins coincides with grooves or 'crenulations' that, in turn, coincide with the line of intersection between the cleavage of the rock and the wall of the vein by which that rock is traversed. The gold-bearing quartz is associated with slate, rather than with sandstone or quartzite, and while there also this association may have been due to chemical causes, it is traceable in part, at least, to structural conditions, whereby the

fissile slate submitted to internal movement more readily than the crystalline quartzite.

As an example of mining operations that proved successful without the guidance of science I may quote Bendigo, in Victoria, Australia. Gold was first found in the alluvial flats in 1851. The precious metal had been concentrated, amid other products of erosion, in the bed of the running stream. The 'digger' first washed the gravel of these placer deposits and then turned to the outcrops of quartz on the adjoining hillside. In the gulch the gold was found among particles of water-worn quartz; in some of these bits of quartz the gold could be seen; hence the inference that the precious metal was originally in a quartz matrix. As a preliminary to finding gold, therefore, it was well to look for quartz. This was not far to seek. On the hillslopes overlooking the placer-diggings were many bold outcrops of quartz. Some of them showed gold and some of them were soft, having been weathered, as indicated by the decomposition of the iron pyrite in the ore, resulting in a reddish honeycombed material easily broken by hammer and pick. Such soft outcrops were smashed readily and washed into the sluice-boxes. Finding gold in the harder quartz also, the digger sank a pit and crushed the ore under a magnified hammer, in the shape of a 'dolly' or rudimentary stamp-mill. Meanwhile lateral exploration, by cross-cut and drift, had proved that the mass of quartz assumed an arched shape. The unsophisticated digger called it a 'saddle.' When his workings penetrated more deeply, he found that the quartz failed. He did not know why. But one of his comrades, more enterprising, sank his shaft still deeper and struck another body of quartz, resembling the one found at the surface in so far as it also had an arched form. It was a second saddle, almost directly under the first. In the course of further exploration downward a third saddle was uncovered. Thus the digger ascertained that these saddles were repeated in vertical succession. He called it a 'line of reef.' A geologist terms it an anticlinal axis. Later, the miner ascertained that there were several of these vertical series of saddles, that they were parallel, and that they had a slope or dip eastward. Thus he got a clue to guide him in his prospecting. It was geology of an elementary kind. He did not go further in his diagnosis of the rock-structure and he failed to recognize the one fact that would have most enlightened his search for ore. To this fact I now come.

¹ 'Certain Dissimilar Occurrences of Gold-bearing Quartz.' By T. A. Rickard. Proceedings of the Colorado Scientific Society. Vol. IV. Pp. 323-339.

² As suggested by my friend Philip Argall. *Op. cit.* Page 333.

³ 'The Domes of Nova Scotia.' By T. A. Rickard. Trans. Inst. Min. & Met. Vol. XX., Pp.

The gold-bearing quartz of Bendigo* conforms to the bedding-planes of Lower Silurian slate and sandstone, near a core (or boss) of granite of Upper Silurian age. These beds of slate and sandstone are also penetrated by thin basic dikes of comparatively recent geologic age, for they are probably Pliocene.



PROSPECTING NEAR PORCUPINE, ONTARIO.

While both the older and younger eruptives may have influenced the deposition of ore, the most salient feature in the local geology is the intense folding of the sedimentary rock, whereby the beds have been bent into acute arches and troughs. Along these, and in the openings thus formed, the gold-bearing quartz has been deposited, but especially along the arches or anticlinal folds, constituting the structure to which the diggers early gave the name of 'saddle.' The ore is usually thick at

the crown of the arch, or apex of the saddle, and thins to nothing on either side, along the so-called 'legs' of the saddle, so that stoping rarely extends for more than 100 feet on the dip. These bodies of ore, however, continue lengthwise, along the strike, like the top of a boiler or the ridge of a roof, through a long series of mining claims, so that the individual

or company owning a mine will extract the ore up to the boundaries of the claim, and on the dip as long as the ore persists. Then the shaft is sunk deeper, and search is made for the next underlying saddle formation, some sign of which may have been obtained in the 'centre country' between the legs of the one last exploited. This is the method whereby the mines of Bendigo have been worked to 4200 feet in vertical depth.

The anticlinal structure, as thus explained, seems obvious, but it is obscured by cleavage, which is at a high angle eastward, so as to coincide roughly with the dip of the east leg, and consequently in opposition to that of the west leg. On account of this fact, namely, the concealment of the stratification by well marked cleavage, the miners and mine man-



ROCK STRIPPED TO FACILITATE PROSPECTING. QUARTZ STRINGERS IN DOLOMITE. PORCUPINE, ONTARIO.

agers of Bendigo did not appreciate the true character of these curious lodes. When I went thither first in 1890, at a time when the deepest mines had already obtained a depth of half a mile, I was told that "the east leg went with the formation, but the west leg went across it." The mine managers had no idea of the essential symmetry of the structure and its close dependence upon the anticlinal curvature of the beds of slate and sandstone. It is an extraordinary fact that the clue to the

* 'The Bendigo Goldfield.' By T. A. Rickard. Trans. A.I.M.E. Vol. XX. Pp. 463-545.

See also 'Types of Ore Deposits.' Edited by H. Foster Bain. Pp. 172-189.

local geology was missed for so long by successive mining engineers and geologists. Up to 1890, that is 39 years after mining started in the district, the only correct observation on the subject was contained in a short note appearing in a quarterly report of the Mining Department of Victoria, for December, 1888, by E. J. Dunn. Even this had attracted no attention, for the local authorities were quite unaware of it when I went to Bendigo two years later. Hence when I first went underground, in April, 1890, in the New Chum & Victoria mine, the manager explained the lode-structure according to the accepted view, pointing to the west leg of a distinct saddle as it crossed the cleavage and to the east leg where it appeared to "follow the formation." And I remember vividly how I jumped to a contrary conclusion, namely, that it was a true anticlinal structure. The key to the local geology was there and I put my hands upon it; nevertheless, failing to obtain indisputable evidence of the stratification, I wavered in my first conviction and it was not until I detected a beautiful example of minute sedimentation in the Lazarus mine, that I had the courage to use the key confidently in opening the doors that led to a correct knowledge of the local geology. One reason for the wrong interpretation by the managers, and for my own hesitation, is the fact that the principal mines in the centre of the goldfield, and those first inspected by me, are in a locality where the cleavage dominates the stratification. Elsewhere in the same district the deceptive harmonies, and the equally deceptive discords, between cleavage and bedding, are less prevalent, so that it becomes much easier to decipher the fundamental structure.

I have dilated on the historic fact that the Bendigo miner worked for 40 years without the key to the geological structure of his lodes because it so happens that his ignorance did not greatly hinder him in his search for gold. His case is the triumph of empiricism. He saw that the quartz had an arched form and that these arched orebodies were repeated in depth. That sufficed to help him in his exploratory work. He was ignorant of the reason for the arched structure and he knew nothing of the natural causes that had produced it, but he had enough light to enable him to grope underground successfully for many years and along miles of subterranean galleries. The geologist told him at a late day that his 'line of reef' was an anticlinal axis and that his 'saddle' marked a fold in the country-rock, but the correct labelling,

with its scientific interpretation, came after about £44,000,000 in pure gold had been extracted in the Bendigo district.

Since the light of science has been vouchsafed,¹ the deeper exploration of the goldfield has been hastened, but inadvisedly.² The Government Geologist asserted that the same rock-structure would continue to great depth and that the conditions favouring the deposition of gold might reasonably be expected to persist concurrently. This gave some sort of justification for the cheerful optimism of the operator and promoter; it led to a craze for deep mining; and it ended in a recognition of a great economic fact, namely, that a gold vein is not necessarily a vein from which gold can be extracted at a profit. This is where the intelligent miner and the clever geologist part company. A vein of quartz must contain a proportion of gold sufficient to meet the cost of exploitation at a given time and in a specific locality. At Bendigo the geologist was of no particular service to the miner; he gave a light, but he suggested a reckless use of that light, prompting the *voyageur* underground to explore recklessly. It is true he gave precision to rule-of-thumb; he sharpened observation; he provided a short cut to conclusions; he gave logical reasons for illogical guesses; he simplified schemes of development, and suggested direction to haphazard exploration. You may say that was enough. I shall not disagree, for my ultimate purpose is to lay stress on the service rendered to mining by geology. Yet it is well for science to be humble in approaching industry. It must make good before demanding the right to dictate. Therefore I shall have pleasure in my next lecture in giving you indubitable examples of the decisively successful application of geology to mining.

¹ The official 'Report on the Bendigo Goldfield,' by E. J. Dunn, appeared in 1893.

² 'The Persistence of Ore in Depth.' By T. A. Rickard. *Mining & Scientific Press*. August 24, 1912.

The Ullrich wet electro-magnetic process is to be installed at the iron mines of the Barrow Hematite Steel Company in north Lancashire, for the purpose of concentrating dump material that has accumulated during the last fifty or more years. The iron ores of north Lancashire and Cumberland have provided supplies for the Bessemer process since its introduction, and have been hitherto sufficiently pure and extensive to be treated raw. The Ullrich process is controlled by Krupps, of Essen, and has been applied successfully at many mines on the continent.

WHAT IS WRONG WITH CORNISH MINING?

A diagnosis, with suggestions for remedy.

By D. GILL-JENKINS

THE above question on a recent newspaper poster has prompted me to repeat it through your columns in the hope that some of your interested readers will assist in an endeavour to ascertain what is wrong and to suggest remedies.

Some may argue that there is nothing wrong with Cornish mining. Those I would ask whether it is not a fact that, with metallic tin at its present price (£150 per ton), Cornish mines have made handsome profits in the past, while today it is an open question whether a single mine in Cornwall is meeting costs.

Again, during the past year a Cornishman known to me was in London trying to raise capital for a mining proposition in the county. His endeavour was fruitless, and at several financial houses he was informed that were the property situated in Nigeria or some other outlandish country there would be no difficulty in finding the money even at one-half the assay-values shown in the report; but in Cornwall, no.

From the foregoing it is evident that something must be wrong with Cornish mining, and in consequence it is not in favour in City financial circles.

Here I would remark that I disagree with the scathing strictures recently passed by the Mayor of Truro on Cornish mine managers. The fault lies not with the managers, but with the system generally adopted in Cornwall. A decided advance was made some years ago when the old cost-book system was discarded in favour of limited liability, but the change was not carried far enough and our mines were not provided with sufficient working capital.

What is wrong with Cornish mining may be briefly summed up as follows:

1. No available working capital.
2. Insufficient development, and consequently no ore reserves.
3. No equalization of dividends fund.
4. General impoverishment of the mines in depth.
5. No subsidiary mines.

(1) This has always been a grievance in connection with Cornish mining, and one has only to examine the records of recent years to

find lamentable instances of failure from this cause.

And what a lot could be done in the way of sinking new shafts, straightening old ones, replacing antiquated winding engines, and improving dressing appliances, with a consequent reduction of working costs, were the necessary capital available.

(2) A Cornish mine manager was recently asked why do not Cornish mine managers, in their yearly or half-yearly reports, give an estimate of ore reserves. His reply was candid in the extreme: "There are none." Exception must be made in the case of the Geevor, whose last report gives an estimate of 78,000 tons, or over two years' supply.

Is it to be wondered that there are no ore reserves when one notes the yearly development figures in the various reports:

| | |
|----------------|-------------|
| Dolcoath | 5,330 feet. |
| Carn Brea..... | 5,317 " |
| Grenville..... | 2,155 " |
| Geevor..... | 3,585 " |

In ratio of tonnage crushed we arrive at the following results:

| | |
|-----------------|---------------------|
| Dolcoath | 1 foot for 21 tons. |
| Grenville | 1 " " 20 " |
| Carn Brea..... | 1 " " 16 " |
| Geevor | 1 " " 6 " |

Again, taking the same mines and working out the proportion of development cost to total working cost, we get:

| | Working Cost | Development Cost | % |
|-----------------|-----------------|---------------------|------|
| Dolcoath..... | 23s. 2d. | 1s. 10½d. | 8'1 |
| Carn Brea | 24s. 5d. | 2s. 1½d. | 8'6 |
| Grenville | 28s. 4d. | 1s. 11½d. | 6'9 |
| Geevor..... | 28s. 2d. | 5s. 7d. | 19'8 |

Note the figures for Geevor; the explanation of that mine's substantial ore reserve is self-evident.

It therefore behoves Cornish companies to abandon the present hand-to-mouth policy, and to increase their development work so as to accumulate 2 or 3 years' ore reserves, as is the general practice abroad.

This progressive policy should be applied not only to lateral developments but also to those in depth. Dolcoath during the past twenty years has been deepened 100 fathoms, or 600 ft.; East Pool during the same period has made no development in depth. What a

contrast is shown by the Indian gold mines, which show an average deepening of 4000 ft. since 1894.

(3) Of late years there have occurred occasional periods of great prosperity in the tin industry, during which the mines must have made good profits. Unfortunately, in most instances, these have been divided up to the hilt and no provision made for the periods of depression that must come in turn.

Mines exploiting a metal fluctuating so widely as tin should earmark a certain proportion of the profits when tin is high to meet such periods of low prices. This system

Again, it was a common occurrence in Cornwall years ago to hear of one mine or another cutting a rich 'bunch of tin,' but now the expression is never heard. Our mines were undoubtedly richer in the shallow horizon than they are at present, and this fact necessitates the handling of a far greater tonnage to attain the same net results.

Further proof of this impoverishment in depth is supplied by the Dolcoath report, which shows that the average produce of the ore has fallen from 79'19 lb. black tin per ton in 1895 to 29'8 lb. in 1913.

(5) There is but one remedy for this general

I.

DETAILS OF RETURNS FOR 1913.

| Mine. | Ore treated | Average recovery | Black Tin extracted | Average Price | Value of Black Tin | Value of By-products | Total Value | Royalty | Net result of Working | |
|--------------------------------|-------------|------------------|---------------------|---------------|--------------------|----------------------|-------------|---------|-----------------------|---------|
| | Tons | Lb. per ton | Tons | Per ton £ | £ | £ | £ | £ | Profit £ | Loss £ |
| Dolcoath | 114,713 | 29'8 | 1,525 | 123 1 9 | 185,637 | nil | 185,637 | 12,376 | 42,193 | — |
| Carn Brea..... | 84,317 | 19'5 | 730 | 112 7 0 | 82,577 | 3,987 | 86,564 | 3,205 | — | 26,668 |
| South Crofty | 69,366 | 20'4 | 633 | 125 0 11 | 78,442 | 21,643 | 100,085 | 3,992 | 21,702 | — |
| East Pool | 68,216 | 17'4 | 528 | 117 12 8 | 62,176 | 7,101 | 69,277 | 2,309 | — | a 4,460 |
| Basset..... | 48,213 | 26'1 | 562 | 117 16 0 | b 67,436 | nil | b 67,436 | 1,428 | 2,631 | — |
| Grenville..... | 43,997 | 34'7 | 682 | 120 12 1 | 82,210 | nil | 82,210 | 4,799 | 20,114 | — |
| Geevor (15 months) | 24,546 | — | — | — | 32,077 | nil | 32,077 | c 1,500 | — | a 5,884 |
| Levant..... (16 weeks only) | 9,053 | 29'4 | 119 | 98 8 3 | 11,711 | 1,023 | 12,734 | 266 | — | 909 |

a. Development costs charged to revenue.

b. Includes 2874 tons burrow stuff treated.

c. Estimated.

would enable a regular dividend to be paid, and would also prevent great fluctuations in the price of shares which are so disastrous to the general public and only beneficial to the few who are in the know.

Probably the natural greed of shareholders is far more responsible for this wrong than the executives of the various mines.

(4) Of recent years it is an established fact all the world over that lodes and veins become impoverished as great depth is attained. Proof of this statement can be found if one examines the record of any of our deep mines. Compare the average value of the ore in the leading West Australian mines today with that of ten or fifteen years ago. Also compare the deep-levels and the deeper deeps of the Rand with their respective outcrop properties; the same tale is told.

impoverishment in depth, and that is that each of the leading mines should possess an outcrop subsidiary to take the place of the parent concern, either when the impoverishment has reached the point where profits vanish or when the limit in depth has been reached. Such an offspring would be vigorously developed during times of prosperity so that when bad times came it would be in a good position to supplement the general out-put.

Needless to remark there are in Cornwall today scores of shallow mines that would make good profits with metallic tin at £150 per ton.

In addition to the foregoing there arises the question of:

1. High dressing costs.
2. Loss of tin.
3. Royalties.

(1) Taking into consideration the comparatively small tonnages handled by Cornish mines, their total working costs per ton compare fairly well with those of foreign mines, although the latter generally have the advantage of coloured labour. It is, however, hard to understand the very high proportion of dressing costs in Cornwall. Note the figures :

| | | | |
|---------------|----------|------------------|---------|
| Basset | 7s. 3d. | out of 26s. 7½d. | = 27·2% |
| Carn Brea.... | 7s. 5½d. | „ „ 24s. 5d. | = 30·6% |
| Geevor | 8s. 9d. | „ „ 28s. 2d. | = 31·1% |
| East Pool.... | 7s. 4d. | „ „ 21s. | = 34·9% |

It is well known that the process of tin dressing is a tedious and often complicated

is absurd. The various tailings are periodically assayed, and a rough idea of the loss is ascertained. It would, however, be much more satisfactory to instal an automatic sampler at each battery. This would take a sample of the pulp, say, every hour, or oftener if necessary, and the collective sample would be assayed daily. The actual contents of the ore crushed would thus be accurately ascertained and a deduction of the tin recovered would indicate the true loss.

It would still be necessary to test the various tailings so as to allocate any abnormal leakage.

(3) Royalties in Cornwall seem to follow

II.

ANALYSIS OF WORKING COSTS.

| Mine | Mining Cost inclusive of Hoisting | | Pumping | | Dressing, inclusive of Transport | | Development | | General Charges | | Total Working Cost |
|------------------------|-----------------------------------|-----------------|-----------|-----------------|----------------------------------|-----------------|--------------------|-----------------|--------------------|-----------------|--------------------|
| | Per ton | % of Total Cost | Per ton | % of Total Cost | Per ton | % of Total Cost | Per ton | % of Total Cost | Per ton | % of Total Cost | Per ton |
| Dolcoath | <i>d</i> | — | <i>d</i> | — | <i>d</i> | — | <i>e</i> 1s. 10½d. | 8·1 | — | — | 23s. 2d. |
| Carn Brea.... | 10s. 1¼d. | 41·4 | 2s. 11¼d. | 12·0 | * 7s. 5½d. | 30·6 | 2s. 1½d. | 8·6 | 1s. 9½d. | 7·4 | 24s. 5d. |
| South Crofty | <i>d</i> | — | <i>d</i> | — | <i>d</i> | — | <i>e</i> 2s. 7½d. | 12·0 | — | — | 21s. 11d. |
| East Pool.... | 7s. 10¼d. | 37·4 | 1s. 11¼d. | 9·2 | 7s. 4d. | 34·9 | 2s. 4d. | 11·1 | 1s. 6½d. | 7·4 | 21s. 0d. |
| Basset | ‡ 8s. 0½d. | 30·2 | 5s. 10¼d. | 22·0 | † 7s. 3d. | 27·2 | 4s. 0¼d. | 15·1 | 1s. 5½d. | 5·5 | 26s. 7½d. |
| Grenville .. | <i>d</i> | — | <i>d</i> | — | <i>d</i> | — | <i>e</i> 1s. 11½d. | 6·9 | — | — | 28s. 4d. |
| Geevor | § 9s. 11½d. | 35·4 | — | — | 8s. 9d. | 31·1 | 5s. 7d. | 19·8 | <i>f</i> 3s. 10½d. | — | 28s. 2d. |
| Levant (16 weeks only) | <i>d</i> | — | <i>d</i> | — | <i>d</i> | — | 3s. 8½d. | 12·3 | 1s. 2½d. | 4·0 | 30s. 1d. |

d. No data available.

e. Estimated at average cost per foot of 40s.

f. Includes general surface.

* No repairs and renewals.

† ‡ of repairs and renewals.

‡ ‡ of repairs and renewals.

§ Includes pumping.

series of operations, but the natural contour of the ground generally in Cornwall is so favourable that, with but little outlay, almost every dressing plant might be made practically automatic, and it should in most cases be possible considerably to reduce this item of dressing costs.

The last Carn Brea report mentions that no less than 266 men, in addition to 23 boys and 36 girls, are engaged in dressing operations. Compare this with the dressing plants on the Lake Superior copper mines, where I have heard it stated jokingly that one can walk about the plant for half an hour without seeing a man.

(2) A statement has recently appeared in print that Cornish mine managers do not know the extent of their loss of tin. This, of course,

no fixed rule, but vary according to the demands of the various landowners. For instance, last year the royalties paid by representative mines were :

| | | |
|--------------------|------|----------------------|
| Dolcoath..... | 6·7% | of the gross output. |
| Grenville | 5·8% | „ „ „ |
| South Crofty | 3·9% | „ „ „ |
| Basset | 2·1% | „ „ „ |

The general average is about 4%, but Dolcoath seems to be heavily penalized in this respect while Basset is to a similar extent favoured.

It would be greatly to the advantage of Cornish mining in general if the royalties were standardized throughout the county, and it would also be more equitable were these exacted on the 'net profit' instead of the 'gross output.' This would ease the mines

when tin was low and would impose the burden when they were best able to bear it. Grenville seems to be the only mine now paying its dues on this system. Were this course adopted it would do more than anything else to attract to Cornwall the capital that is being diverted to foreign mining districts.

One would also wish to see the establishment of a board to consist of the managers of the leading mines of the county. These would meet, say, monthly, or oftener, to discuss matters pertaining to the common welfare of the mines, and much economy could

and candles, as well as labour cost per foot of progress. It is only by a close comparison of this kind that economies can be effected and the average rate of development increased.

In addition, the board would have control over the rate of wages paid, so as to secure uniformity in this respect in the various mining districts.

Such a board, working harmoniously, could not fail to be of material benefit to the tin-mining industry, and the suggested co-operation and interchange of ideas would have a far-reaching effect.

III. PROFIT AND LOSS, DEVELOPMENT, AND ORE RESERVES.

| Mine | Extraction Value | Working Cost excluding Royalty | Royalty | Profit | Loss | Development | | | | Ore Reserves |
|------------------------|------------------|--------------------------------|-----------|-----------|-----------|-------------|----------|----------------------|-----------------------|--------------|
| | Per ton | Per ton | Per ton | Per ton | Per ton | Footage | Cost £ | Cost per ton treated | Tons treated per foot | Tons |
| Dolcoath | 32s. 9d. | 23s. 2d. | 2s. 2d. | 7s. 4d. | — | 5,330 | g 10,660 | 1s. 10½d. | 21 | <i>h</i> |
| Carn Brea.... | 20s. 6d. | 24s. 5d. | 9d. | — | l 6s. 4d. | 5,317 | 9,024 | 2s. 1½d. | 16 | <i>h</i> |
| South Crofty | 28s. 10d. | 21s. 11d. | 1s. 2d. | m 6s. 3d. | — | 4,588 | g 9,176 | 2s. 7½d. | 15 | <i>h</i> |
| East Pool..... | 20s. 4d. | 21s. 0d. | 8d. | — | 1s. 2d. | 4,187 | 8,015 | 2s. 4d. | 16 | <i>h</i> |
| Basset | 27s. 5½d. | 26s. 7½d. | 7d. | n 1s. 1d. | — | 3,804 | 9,564 | 4s. 0¼d. | 12 | <i>h</i> |
| Grenville | 39s. 0d. | 28s. 4d. | 2s. 2d. | o 9s. 2d. | — | 2,155 | g 4,310 | 1s. 11½d. | 20 | <i>h</i> |
| Geevor | 26s. 1d. | 28s. 2d. | j 1s. 2d. | — | k 4s. 9d. | 3,585 | 6,860 | 5s. 7d. | 6 | 78,000 |
| (15 months) | | | | | | | | | | |
| Levant (16 weeks only) | 28s. 1½d. | 30s. 1d. | 7d. | — | 2s. 0d. | 833 | g 1,666 | 3s. 8¼d. | 10·9 | <i>h</i> |

g. At estimated cost of 40s. per foot. *h.* None reported. *j.* Estimated at £1500. *k.* Includes £1938 interest charges (1s. 7d.).
l. Includes capital expenditure £9634 and £1800 credited for sale of sand. *m.* Includes interest.
n. Includes profit on burrow stuff treated. *o.* Includes interest.

be effected by their placing collective orders for coal, timber, and stores.

There would be a candid interchange of views on such subjects as the probable continuation of certain lodes in adjoining setts, peculiar characteristics of the various lodes, tin losses, the efficiency of different dressing machines, and the conditions under which the best results were obtainable. The board would also carry out any experimental tests of new processes or machines, instead of the mines doing so individually, as at present.

The board would also have its statistical department, which would follow and compare the working costs of the various mines. It would receive from each mine a monthly return showing working costs in detail, together with cost of shaft-sinking, rises, winzes, and levels, with consumption of explosives, steel,

Annexed are five schedules, which have been compiled in connection with the foregoing remarks, and which may prove of some interest. A few points may be mentioned. Grenville has the richest ore and East Pool the poorest. In spite of its complex ore, South Crofty obtained the highest average price for its concentrate. Levant shows the highest working cost and East Pool the lowest. As regards labour efficiency, Basset easily leads with 191 tons broken for each underground employee; under this heading Levant comes last with 102 tons only. In development, Dolcoath and Grenville make a poor show with 1 ft. for 21 and 20 tons treated, respectively. As regards royalties, Dolcoath pays 2s. 2d. per ton treated, or 6·7% on the ore value; Grenville also paid 2s. 2d. per ton treated, but the basis is on profits only.

IV. DETAILS OF EMPLOYEES AND ORE TREATED.

| Mine | Employees | | | | | | Ore Treated | | | |
|--------------------------------|--------------|---------------------|--------------|------------|---------------------------------------|-----------------------------------|--------------------|-------------|-------------|------|
| | Total Number | Average Annual Wage | Under-ground | % of Total | Tons broken per under-ground employee | Tons treated per surface employee | Black Tin Contents | Recovery | Loss | Loss |
| | | | | | | | Lb. per Ton | Lb. per Ton | Lb. per Ton | % |
| Dolcoath..... | — | — | — | — | — | — | — | 29·8 | — | — |
| Carn Brea..... | 1053 | — | 517 | 49·1 | 163 | 157 | 29·1 | 19·5 | 9·6 | 33·0 |
| South Crofty..... | — | — | — | — | — | — | — | 20·4 | — | — |
| East Pool..... | — | — | — | — | — | — | 23·88 | 17·4 | 6·48 | 27·2 |
| Basset..... | 444 | £75 18 1 | 253 | 57·0 | 191 | 252 | — | 26·1 | — | — |
| Grenville..... | 463 | £76 5 4 | 268 | 58·1 | 164 | 225 | — | 34·7 | — | — |
| Geevor..... (15 months) | — | — | — | — | — | — | — | — | — | — |
| Levant..... (16 weeks only) | 452 | £62 18 10 | 288 | 63·7 | 102 | 179 | — | 29·4 | — | — |

Where spaces are vacant figures are not available.

V. FURTHER DETAILS.

| Mine | Labour Cost | | Materials | | Explosives | | Royalty | | Depreciation |
|--------------------------------|-------------|----------------|-----------|----------------|------------|----------------|-------------------|------------------------------|--------------|
| | £ | Per ton of ore | £ | Per ton of ore | £ | Per ton of ore | % of output value | % of Profit before deduction | £ |
| Dolcoath..... | 79,947 | 13s. 11½d. | 44,155 | 7s. 8½d. | 1,677 | 3·5d. | 6·7 | 23 | 9,886 |
| Carn Brea..... | — | — | — | — | — | — | 3·7 | — | nil |
| South Crofty.... | 44,764 | 12s. 10½d. | 26,155 | 7s. 6½d. | — | — | 3·9 | 16 | 2,815 |
| East Pool..... | — | — | — | — | — | — | 3·3 | — | nil |
| Basset..... | 33,701 | 13s. 11½d. | 28,030 | 11s. 9d. | 1,822 | 9·1d. | 2·1 | 35 | 2,253 |
| Grenville..... | 35,311 | 16s. 0d. | 22,218 | 10s. 2d. | — | — | 5·8 | 16 | nil |
| Geevor..... (15 months) | — | — | — | — | — | — | — | — | 415 |
| Levant..... (16 weeks only) | 8,957 | 19s. 9½d. | 4,116 | 9s. 1d. | — | — | 2·0 | — | nil |

Depreciation must be deducted from Profit to ascertain Net Profit.

Where spaces are vacant figures are not available.

MINERAL RESOURCES OF THE BELGIAN CONGO.

Katanga Copper Deposits and Production. Development of Diamond
and Tin Deposits. Gold Placers.

By SYDNEY H. BALL & MILLARD K. SHALER.

Introduction.—The Belgian Congo, the scene only 35 years ago of Stanley's explorations, has for the past decade been prospected by the State and by a number of concessionary companies, some powerful financially, and all notable for the size of their concessions. Three years ago certain portions of the colony were opened to individual prospectors, but the present mineral production (valued at about £600,000 in 1913) is wholly the fruit of work of the concessionary companies and the State. Judging from the natural resources of the country, a healthy expansion of mining may be expected in the near future.

The Belgian Congo lies between the African lakes and the Atlantic ocean, and between 5° north and 14° south latitude. Having an area of 908,000 square miles, it is about seventeen times as large as England. Nineteen days after leaving Antwerp the steamer passes up the Congo river to Matadi, through the low, slightly undulating and narrow, coastal plain. From that seaport a train is taken to Kinshasa, through an ancient mountain range, now a dissected peneplain, usually referred to as the Crystal mountains. Kinshasa, situated near the upper end of the Livingstone rapids, is the point from which the fleet of river steamers depart, to ply upon the 7000 miles of navigable waters of the Congo river and its numerous important tributaries. From Kinshasa the great level interior basin, with its slow brownish streams, is entered, and upon being traversed for a thousand or more miles, the hilly country of the north or south frontier region is reached, where the streams are divided into navigable and non-navigable stretches by numerous waterfalls and rapids. The eastern border of the colony is mountainous, with a maximum altitude of 16,800 feet at Ruwenzori.

At present there are 960 miles of railway in the colony, the lines for the greater part being around non-navigable river stretches, or connecting important points on neighbouring waterways. The arrival of the railhead at Kambove, Katanga, in the middle of last year, put that mine within six and a half days travel

from Cape Town. The German railway from Dar el Salaam to Lake Tanganyika having just commenced operation, upon the completion of the Belgian railway from the Congo river to the lake, tickets can be bought, some time this year, permitting the tourist to cross Darkest Africa by an all rail and steamer route. The several short telegraph lines are supplemented by a number of wireless stations, owned and operated by the State.

It surprises the new-comer to find that one-half of the country consists of savanna, and that the great equatorial forest lies only between parallels 4° N. and 4° S. of the equator, most of it being south of the great horse-shoe bend of the Congo river. The climate of the colony is one of heavy rainfall, high humidity, and relatively high temperature. North of the equator the rainy season corresponds approximately to our summer, and the dry to our winter; south of the equator the seasons are reversed.

Mines are operated under considerable difficulties, and costs are high; operations are at a great distance from the home office, transportation is slow and expensive, and native labour is inefficient, and in some regions insufficient. White men, if proper care is exercised in their selection, both as to physique and temperament, are able to render much more satisfactory service than would appear to be the case in other parts of tropical Africa, the Gold Coast, for example. It is rare that anyone has reason to regret the two years spent in the colony, the usual term of service, and the average man sooner or later feels the lure of tropical life, and returns.

Strangely enough, the colonial government, instead of subsidizing mining enterprises, loads them with excessive royalties and taxes, and as a result some companies hesitate to begin exploitation, particularly where the product is of comparatively low value. The colonial office has, however, recently shown a disposition to reduce these charges, and thus to foster further development. The industry would likewise be advanced by legislation increasing the prestige of the white man among

the now pampered blacks, and by the spread among the latter of both education and an understanding of sanitary living.

We wish to remark here that this article is founded not only on our own observations and those of our associates, but also upon the writings and personal communications of Messrs. Cornet, Buttgenbach, Studdt, Mer-

the upper reaches of the river are approached, isolated inliers of older rocks appear in valleys cut through the sandstone-shale blanket. On the rim of the basin these rocks are dominant, as they are in the Crystal mountains. They can be broadly separated into two series, presumably of pre-Cambrian and Paleozoic age, respectively. The first consist of various



THE BELGIAN CONGO.

cenier, Jadot, Van Bree, and others conversant with mining in the Belgian Congo.

Geology.—The coastal plain is underlain by sandstone, limestone, and shale, of Tertiary and Cretaceous age, which dip toward the Atlantic ocean. The central basin is covered by interbedded sandstones and shales of Jura-Triassic age, which are either flat or dip gently toward its centre near Lake Leopold II. As

schists and gneisses, and gabbros and granites intruded in each. The second are sandstones, quartzites, slates, shales, and limestones.

These older rocks, which in late Paleozoic time were peneplained, are complexly folded and faulted. The structural lines on the north and south frontiers have an east and west trend, and those of the Crystal mountains parallel the Atlantic ocean. The old north and

south folds of the region west of the great lakes were later planes of weakness, along which the block-faulting occurred by which these lakes were formed.

Many of the iron ore and gold occurrences, and some of the less important copper deposits, are genetically dependent upon the supposedly pre-Cambrian intrusions. Due to the deep erosion which the pre-Cambrian rocks have suffered, and the African plateau is a notable example of a region of deep erosion, these ore deposits are replacements, fissure veins, series of linked lenses, magmatic segregations, and pegmatitic veins. In the Katanga region, the southeastern portion of the colony, however, is a thick series of sedimentary rocks, probably ranging in age from pre-Cambrian to Triassic. Two granites, each followed by basic igneous rocks, were successively intruded into these sedimentary rocks in presumably early and middle Paleozoic time. The tin deposits were formed by the magmatic waters of the earlier intrusion, and Studt ascribes to the later the Katanga copper deposits. For the time being, however, this conclusion must be taken with reserve.

Important metallic mineralization appears to have ceased throughout the colony by or prior to mid-Carboniferous time. The diamonds of the Katanga, on the other hand, are perhaps of Cretaceous age, although those of the Kasai region may be of considerably earlier origin, the evidence at hand indicating that, as in South Africa, diamonds were formed at two distinctly different periods.

With the exception of coal, oil shales, and the probable presence of diamonds, the flat-lying sandstones and shales of the central basin are not of economic interest; nor is the coastal plain important from the miner's point of view, unless the presence of highly bituminous sandstone is indicative of petroleum.

Three regions are of economic interest: the Katanga, in the southeast, with copper, tin, gold and diamond deposits; the Aruwimi-Welle region, in the northeast part of the colony, with gold and iron deposits; and the Kasai region, in the southwest portion, with diamonds and iron.

Copper.—The Katanga copper mines, owned by the Union Minière,* produced in 1913 about 7200 long tons of crude copper, representing in value over 70% of the colony's mineral production in that year. The indus-

try, however, is an ancient one, for long before the Portuguese pombeiros (half-caste traders), P. J. Baptista and Amaro Jose, visited the mines in 1802, the natives had mined and smelted a large amount of copper, and had fairly riddled the richer deposits with pits. Atherton estimates that at least 100,000 tons of copper were produced by them or by their predecessors. The Katanga copper belt is now connected by rail with Beira, its seaport. After a long period of preparation, smelting was begun in June, 1911. The management passed into Belgian hands in 1912, and at present the Union Minière is one of the fifty largest copper producers of the world. Mr. P. K. Horner is general manager in Africa, and Mr. A. E. Wheeler, the former superintendent of the Great Falls smelter in Montana, is consulting engineer. About 200 whites and over 2000 blacks are employed in the smelter and mines. The belt lies in southeastern Belgian Congo, not far north of the Rhodesian frontier. To date 160 deposits have been discovered in a belt from 30 to 60 miles wide, extending 90 miles east from the Lufupa river, and thence bending sharply east-south-east for 110 miles. The region is a ruggedly dissected plateau, ranging in elevation from 3900 to 5200 feet. On account of its elevation and its situation, 750 miles from the equator, the climate of the Katanga is not particularly trying. As the cupriferous rocks are more resistant to erosion than the surrounding country rock, the orebodies usually form cones or ridges. The cupriferous tracts are generally bare, and between them and the dense forest of the region is usually an annular belt covered by the misuku bush. This, together with the topographic prominence of the outcrops and the presence of ancient open-cuts, rendered copper prospecting comparatively simple.

In addition to granites and basic igneous rocks, the Katanga region is composed of sedimentary rocks, largely quartzose, ranging in age presumably from pre-Cambrian to Triassic, the copper-bearing rocks according to Studt being of middle Silurian and Devonian-Silurian age. The mineralized rocks include sericite schist and quartzose rocks, ranging from soft shaly sandstone to pure quartzite, and occasionally slate, limestone, and a cellular quartzose rock. The latter is a silicified dolomite. The rocks of the copper belt lie in rather close folds, which strike from WNW to ESE and have a predominant dip to the north. The copper deposits in consequence occur along WNW to ESE lines. The orebodies are

* The Katanga copper belt is more familiarly known in England and America as the property of the Tanganyika Concessions Ltd., which, however, has about a 42% interest in the holdings of the above named company, and in addition, holdings in other properties.

situated at points of sharp folding, faulting, or of an unusual amount of brecciation. The orebodies are tabular masses, which usually follow bedding-planes, although in instances they, according to Studt, cross them, following instead schistose planes. Several ore lenses may replace one another in the same rock bed. The deposits lie in the schistosity planes of the schists, or the bedding planes of sandstone, and in addition impregnate both rocks or cement their brecciated portions. The most abundant copper minerals are mala-

mercial value, others are large; the Kambove No. 2 deposit, for example, is said to be 3000 ft. long and, so far as tested, from 240 to 400 ft. wide. Most of the ore is highly silicious, although some is aluminous, and still other dolomitic. With the exception of the Star of the Congo ore, which is practically without precious metal content, appreciable gold and silver values accompany the copper, reaching respective maximums of 3 grammes and 72 grammes per metric ton. The percentage of cobalt in the crude copper is notable, and if



STAR OF THE CONGO MINE.

chite and chrysocolla; less abundant are azurite, copper pitch ore, and melaconite. As rarities cuprite, diopside, native copper, lunite, libethenite, olivenite, and cyanotrichite occur. Sulphides occur sparingly, even at depths of 60 metres or at a considerable distance below water level. The gangues consist of calcite, quartz, chalcedony, dolomite and oxides of iron, manganese, and cobalt, and at one mine, barite.

Tonnage figures cannot be given, but the reserves of 10% ore are sufficient to permit of a large production for a considerable number of years. Although some of the deposits are too small to be of more than problematic com-

this by-product be separated, Katanga should furnish a considerable portion of the world's supply. In 1911 the crude copper carried from 89 to 90% copper, 4 to 5% cobalt, 0.3% iron, and 1.1 sulphur, and during 1912 and 1913, 94 to 95% copper, 2 to 3½ cobalt, 0.8 iron, and 0.8 to 1 sulphur.

The Katanga copper deposits are so similar to one another in form and mineral paragenesis that they presumably are all of a common origin. Numerous hypotheses as to their genesis have been advanced, some believing them the oxidized outcrops of sulphide veins, others beds of sedimentary origin, still others the work of descending waters, and yet

others, perhaps with most reason, replacement deposits by ascending waters.

At present, three mines, the Star of the Congo, Kambove, and Luushia, are producing; and the Luiswishi, Likasie, and Chituru mines are being developed. The Star of the Congo, from which alone up to June 1913 ore was extracted, is in a position to produce monthly about 15,000 tons, of which 7000 tons will be discarded as waste, and in part stored

Stirling boilers. In the second half of 1913, 2'9 tons of coke was used per ton of copper produced.

The flux consists of hematite obtained from Musoshi, 65 miles south of the smelter, dolomitic copper ore from the Star mine, and limestone from Mikola, 20 miles south of the smelter.

The table below summarizes the smelting operations:

RESULTS OF SMELTING AT LUBUMBASHI.

| | Number of days working | Ore smelted. Tons | Copper content of ore. % | Ingot copper produced. Tons | Copper in ingots % | Tons of copper matte | Copper in matte % | Production of copper per working day Tons |
|------------------|------------------------------|----------------------|-----------------------------------|-----------------------------------|--------------------------|----------------------------|-------------------------|--|
| 1911..... | 88 | 10,300 | 12 to 13 | 786 | 90 | — | — | 11'3 |
| 1912..... | 171 | 20,900 | 13 to 15 | 2404 | 95 | 88 | 65 | 14'0 |
| 1913 (11 mo.); | | | | | | | | |
| 1st furnace..... | 208 | 48,500 | 15 to 16 | 6240 | 96 | 130 | 65 | 15'6* |
| 2nd furnace..... | 90 | | | | | | | 33'4† |

* With 1 furnace operating.

† With 2 furnaces operating.

for future treatment. This mine has been worked as an open-cut with hand labour, but since early in 1914, two small steam shovels supplied by the Bucyrus company and having buckets of $\frac{1}{2}$ cubic yard capacity have been employed in stripping overburden and mining soft ore. At Kambove, about 800 tons of ore per week are extracted by hand labour in an open-cut. The mine will, however, soon be worked with two steam shovels, one a Bucyrus of 48 tons weight and the other a Koppel of 49 tons weight, each having a dipper of $1\frac{1}{2}$ cu. yd. capacity. The Luushia mine, on the Elisabethville-Kambove railroad, 56 miles from the smelter, can furnish daily 100 tons of friable ore. In addition to a certain amount of hand sorting, the ore is screened and washed and the talcose ore treated in log-washers. The fine ore is briquetted prior to smelting, in a plant consisting of 6 presses, with a capacity of 250 tons per 20 hours; no binder is used.

Two water-jacket furnaces, 48 by 192 in. at the tuyeres, and of 300 tons capacity, are installed at Lubumbashi, near Elisabethville, and a third is now being erected and will be blown-in early this summer. With the latter in readiness, two furnaces can be run continuously. Formerly European coke, costing £13 per ton, was used, but coke made from washed coal from Wankie, in Rhodesia, has been substituted. Part of this is produced at Wankie, but in December 1913, 22 Coppée coke ovens, with a monthly capacity of 1500 to 1750 tons, were completed at the smelter, and a second similar unit should now be running. The waste gases are used to heat two

The Union Minière reports that with washed Wankie coke as fuel when both furnaces are in blast, copper delivered on board the train at the smelter costs about $6\frac{1}{2}$ cents per pound or £29 per long ton, or delivered at Antwerp about 8'5 cents or £39 per ton. Neither European expenses, debenture interest, amortization of plant, nor marketing charges are included in this figure. Of course the average cost of copper produced in the past has been greater, as both furnaces have not been in commission all of the time. Four additional blast-furnaces have been ordered and will presumably be in commission sometime during 1915.

Of the four great obstacles to be overcome in increasing the production, three have at least for the present been solved, namely, transportation, the fuel situation, and the ore supply. The fourth, labour, is as yet troublesome, but will presumably be satisfactorily handled. The company has lately entered into a contract with the Nyasa Consolidated Co. for a supply of Nyasa natives, and about 800 workmen have been recruited up to the present. The Katanga should this year enter the ranks of those districts producing about 12,000 long tons of copper, at a cost roughly comparable to that of the Lake Superior district.

Deposits, consisting of cupriforous quartz veins and lenses, lenses of chalcopyrite in schist, magmatic segregations, and beds in red sandstone, are widely distributed in the pre-Cambrian and Paleozoic rocks on the borders of the Belgian Congo basin, but none except those of Katanga are known to be exploitable.

About six years ago a few tons of rich copper ore was extracted from quartz-chalcocitelenses at Bamanga, near Ponthierville, but this mine has since been abandoned.

Gold.—Between 1904 and the end of 1913 the Belgian Congo produced placer gold valued at £650,000, and in the next five years an equal amount should be produced. The 1913 production was approximately £160,000. New discoveries are reported every year, but although some are fairly rich, they are not generally large, and the margin of profit is

The gold is worth about 75 shillings per ounce, silver being the chief impurity.

Kilo, by far the most important placer, occurs in a diorite and granite country. The gold is presumably derived from pyritiferous quartz stringers in the diorite, and along its contact with the granite, as the streams become barren upon leaving the diorite and pass into the granite. The gravel ranges in content from 22d. or less to 150s. per cubic yard. The overburden and 'pay-streak' vary much in thickness, reaching a maximum of $4\frac{3}{4}$ feet,



THE LUBUMBASHI SMELTER.

small. No workable lodes or veins have been found, and unless with more detailed prospecting gold deposits not connected with placers are discovered, there is as yet no reason to believe that the colony will add largely to the world's gold supply.

Gold is widely disseminated in the colony, and colours are found even in the country underlain by the flat-lying sandstones of the central basin, but the profitable placers are confined to the northeastern part. This is a region of ancient rocks which have been deeply eroded, causing the collection in present-day streams of the gold once widely distributed in stringers, or other non-commercial deposits.

and averaging about $1\frac{1}{8}$ ft. The bottom consists of greenish clay, the altered diorite country-rock, and the gold penetrates it for 4 and, in instances, even 8 inches. The gravel is excavated largely by pick and shovel, although in part by a small giant, and the gold is recovered in sluices. To date about £520,000 has been produced, and over £1,000,000 worth of gravel is said to be blocked-out. About 30 whites and 2000 blacks are employed.

Moto is a much smaller placer. It was first operated in 1911, and has produced about £120,000, with a larger amount still to be extracted. Seven whites and 1300 blacks are employed. The country-rock is reported to

be granite, diorite, and hematite schists.

The Kanwa placer lies at the headwaters of the Tele river in a heavily wooded, ruggedly dissected plateau country. The country-rock is a schist-gneiss complex, cut by granite dikes and masses; one member of the complex is a quartzite, partly or completely replaced by hematite. Quartz stringers and lenses, some of which at least are auriferous, occur near the iron-ore band, and others at the contacts between the gneiss and schist. Below such quartz stringers the gravel is enriched. At Babeyru, a placer just beginning production, hematite schists are also important country-rocks.

Gold is widely distributed in the Katanga, and detrital and placer gold deposits are derived from the breakdown of five of the copper deposits, the copper ore as noted above being slightly auriferous. The Ruwe lode in the Katanga copper belt is interesting. Structurally this resembles the Katanga tabular bodies, and indeed some copper is present. The mineralized portion of the sandstone is reported to be 1200 ft. long, and to vary in width from 3 to 20 ft., averaging 8 ft. The assay-values are uneven and are said to average 70s. per ton in gold, platinum, and palladium, and some silver. Downhill from the lode is a detrital gold deposit, from which, eight years ago, about £40,000 was won.

Diamonds.—Diamonds have been found at three distinct places within the Katanga, over a large area in the middle reaches of the Kasai river region, and at three, and probably five, of the gold placers in the northeastern part of the Congo.

The Kasai alluvial diamond field is now producing on a small scale, and the pipes of the Kundelungu plateau in the Katanga may later prove to be of commercial importance. The Société Internationale Forestière et Minière du Congo, a Belgian-American corporation, has a monopoly of the Kasai diamond field, discovered in 1907. Production began in June 1913, and in the last half of 1913, with a small force in the field, 15,000 carats was recovered. The Kasai region consists of a basement of supposedly pre-Cambrian schists, gneisses, and granites, on the peneplained surface of which are practically flat-lying sandstone, shale, and conglomerate of Jura-Triassic age. The conglomerate furnishes at least many of the well rounded silicious pebbles that make up the terrace and river diamond-bearing gravels, and also many of the minerals associated with the diamonds (garnet, cyanite, tourmaline, iron ores, etc.), and with

strong presumption at least also the diamonds. If this inference be justified, the stones are older than those of the South African pipes. This diamondiferous area within the Belgian Congo is 105 miles long from north to south, with a determined width of at least 45 miles. Rich gravels occur in some of the smaller streams where great re-concentration has taken place, and also in certain channels in some of the terrace gravels. It is expected that some of the terrace gravels, and those of certain portions of the larger streams, can be dredged. The average size of the stones is small, perhaps one-tenth of a carat, and the largest stone found so far weighs a little less than 15 carats. As to water, the stones are the analogue of those of German South West Africa, with a fair percentage of blue-white stones and some fancy colours, of which an apple green, a topaz yellow, and a morganite pink are notable. Octahedrons predominate, but dodecahedrons, cubes, and other crystal forms also occur.

In the Kundelungu plateau intrusive pipes of a basic igneous rock, presumably similar to kimberlite but altered to a 'yellow ground,' cut the Kundelungu (Permian) red sandstone. Structurally, and presumably lithologically, these pipes resemble those of South Africa, and so far as our knowledge goes, they are probably contemporaneous intrusions. Some 40 pipes have been discovered, the largest having an area of 45 acres. The Luanza pipe has been tested on a small scale, and several hundred stones have been recovered. The concentrate closely resembles that obtained at Kimberley. In the colony 40 white men and about 1000 blacks are employed in diamond prospecting and exploitation.

Tin.—As far back as 1906 the Union Minière du Haut Katanga smelted ten tons of tin concentrate in a furnace constructed on the ground, and measures are being taken at Busanga to start production on an industrial scale. A small concentrating plant has been shipped. Ten tons of tin concentrate was produced monthly in 1913 at Muika, where the Société de Recherches Minières du Bas Katanga has a 5-stamp mill and concentrating plant. Bids are being received for a considerably larger equipment. The properties of both companies lie on the northwest face of the dissected plateau named Monts Mutumba, where a belt 250 miles long appears to contain several promising tin prospects. The strike of the belt is NE to SW and the rocks consist of mica schist, quartzite, and slate, intensely intruded by granite and pegmatite.

Cassiterite occurs in lodes of pegmatite and greisen, in detrital deposits, and in stream placers. The deposits appear to be fairly extensive and of good tenour, but are in isolated positions, and can scarcely be worked at a profit, considering the difficulties of transportation and the excessive taxes levied by the government.

Coal.—There is little hope that high-grade coal will be found in the Belgian colony, but coal of about the quality of Rhodesian localities (Wankie excepted) has already been found, and further discoveries will presumably be made as a result of more exploration. The most important district is that in the Lukuga valley near Lake Tanganyika. In rocks presumably equivalent to the Eccra series of South Africa, five coal beds from 2 to 6½ ft. thick are intercalated with flat-lying sandstones and shales. The coal contains from 28 to 45% volatile matter, and 18 to 20% ash, and is non-coking.

Other Minerals.—Iron ore deposits of good grade are abundant in the rim regions of the Congo basin, but are not likely to be mined at any early date. Manganese is among the metals that may later be exploited, while the deposits of lead, zinc, silver, antimony, arsenic, bismuth, tungsten, the rare earth metals, and aluminium, found so far, are believed to be of little importance. Among the economic minerals occurring in varying quantity may be mentioned corundum, chrysoberyl, cyanite, and other semi-precious stones, mica, graphite, barite, fluor spar, asbestos, and strontianite.

EARLY MICROSCOPICAL STUDIES.

In his presidential address before the Faraday Society, Sir Robert Hadfield referred to the large part now played by the microscope in metallurgy and geology.

Without doubt Sorby was the first to originate metallography, or the study of the micro-structure of iron and steel, as well as other metals. His earliest research work was done in 1849, when he prepared the first rock slice ever made, and his first microscopical study of igneous rocks was presented in his great paper, read before the Geological Society of London on December 2, 1857. Incredulity existed generally at the time as to the value of his work. Smiled at by Professor Tennant when about to begin the research, jeered at by his friend, Leonard Horner (Vice-President of the Geological Society), who, at the meeting to

which the results were presented, remarked from the chair that "he had been a member of the Geological Society ever since its foundation, and during the whole of that time he did not remember any paper having been read which drew so largely on their credulity," Sorby lived on to have those same results acknowledged and to be acclaimed by the geologists of all nations, assembled to celebrate the centenary of the foundation of the Geological Society of London, as the founder of modern petrology.

Sorby's first work on the microscopical study of metals was in 1863. In 1864 he lectured on this topic in Sheffield, later in the same year communicating his results to the Bath meeting of the British Association. Sir Robert said he remembered, in 1886, taking some of his first specimens of manganese steel to Dr. Sorby, in order to ask his views with regard to the micro-structure of this curious alloy of iron and manganese.

It was in 1885 that Dr. Sorby was first able to show the true composite nature of the 'pearly constituent' of steel, as an aggregate of parallel plates. This discovery was the earliest recognition of the formation of crystals from a solid solution, and may be considered as the crowning achievement of his microscopical research. It was announced to the Iron and Steel Institute in 1886, and in 1897 in his paper on 'The Microscopical Structure of Iron and Steel.' Soon afterwards, these discoveries appeared to be the signal for great activity in the metallographic field, which he so brilliantly had started to explore.

It is not always possible to show who is the real originator and discoverer of lines of new thought. In this case, however, the pioneer's honour in leading the way in the study of the micro-structure of metals is due to Dr. Sorby, and to him alone. Happily, the mantle of Sorby as regards microscopy fell upon young and able shoulders in Sheffield, and Arnold, who has continued and greatly enlarged this important science, was for many years in close touch with the great master Sorby, of whom Sheffield is so proud. Stead, Osmond, Sauveur, Heyn, and many others have assisted the good work. Kohn in his book published in 1867 devoted a couple of columns to the consideration of 'Steel Under the Microscope,' but Dr. Percy, in his classic work of more than a thousand pages, 'The Metallurgy of Iron and Steel,' published a little earlier than Kohn's work (1864), never even referred to the subject of the study of the micro-structure of iron and steel.

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

| | July 1 1913 | June 1 1914 | July 1 1914 |
|--------------------------------------|----------------|----------------|----------------|
| GOLD, SILVER, DIAMONDS: | | | |
| RAND: | | | |
| Bantjes..... | 20 | 13 | 14 |
| Brakpan..... | 66 | 42 | 51 |
| Central Mining (£12)..... | 182 | 156 | 160 |
| Cinderella..... | 8 | 6 | 6 |
| City & Suburban (£4)..... | 50 | 48 | 52 |
| City Deep..... | 52 | 66 | 66 |
| Consolidated Gold Fields..... | 47 | 42 | 43 |
| Consolidated Langlaagte..... | 26 | 33 | 35 |
| Consolidated Main Reef..... | 17 | 17 | 18 |
| Crown Mines (10s.)..... | 136 | 117 | 120 |
| Durban Rodepoort..... | 23 | 21 | 21 |
| D. Rodepoort Deep..... | 22 | 16 | 17 |
| East Rand Proprietary..... | 50 | 32 | 33 |
| Ferreira Deep..... | 60 | 46 | 47 |
| Geduld..... | 20 | 23 | 23 |
| Geldenhuis Deep..... | 30 | 25 | 26 |
| Heriot..... | 60 | 60 | 55 |
| Jupiter..... | 9 | 4 | 5 |
| Kleinfontein..... | 21 | 22 | 24 |
| Knight Central..... | 9 | 7 | 8 |
| Knight's Deep..... | 45 | 31 | 35 |
| Langlaagte Estates..... | 23 | 18 | 20 |
| Luipaard's Vlei..... | 8 | 9 | 10 |
| Main Reef West..... | 10 | 6 | 7 |
| Meyer & Charlton..... | 100 | 115 | 115 |
| Modderfontein B..... | 76 | 84 | 89 |
| Modderfontein, New (£4)..... | 247 | 253 | 263 |
| Nourse..... | 31 | 27 | 27 |
| Primrose..... | 33 | 22 | 21 |
| Rand Mines (5s.)..... | 126 | 118 | 120 |
| Randfontein Central..... | 60 | 18 | 17 |
| Robinson (£5)..... | 33 | 55 | 57 |
| Robinson Deep..... | 27 | 27 | 33 |
| Rose Deep..... | 60 | 42 | 43 |
| Simmer & Jack..... | 12 | 10 | 12 |
| Simmer Deep..... | 3 | 1 | 1 |
| Springs..... | 15 | 11 | 11 |
| Van Ryn..... | 73 | 67 | 67 |
| Van Ryn Deep..... | 30 | 45 | 47 |
| Village Deep..... | 41 | 37 | 40 |
| Village Main Reef..... | 41 | 36 | 40 |
| Witwatersrand (Knight's)..... | 72 | 68 | 71 |
| Witwatersrand Deep..... | 57 | 52 | 48 |
| Wolhuter..... | 14 | 15 | 14 |
| RHODESIA: | | | |
| Cam & Motor..... | 30 | 19 | 19 |
| Chartered..... | 19 | 17 | 17 |
| Eileen Alannah..... | 10 | 10 | 11 |
| Eldorado..... | 17 | 18 | 18 |
| Enterprise..... | 9 | 8 | 9 |
| Falcon..... | 15 | 11 | 14 |
| Giant..... | 10 | 13 | 14 |
| Globe & Phoenix (5s.)..... | 27 | 32 | 32 |
| Lonely Reef..... | 50 | 26 | 27 |
| Shamva..... | 46 | 43 | 46 |
| Wanderer (5s.)..... | 2 | 2 | 3 |
| Willoughby's (10s.)..... | 9 | 7 | 7 |
| OTHERS IN SOUTH AFRICA: | | | |
| De Beers (£2 10s.)..... | 430 | 332 | 330 |
| Glynn's Lydenburg..... | 16 | 11 | 11 |
| Jagersfontein..... | 130 | 81 | 78 |
| Premier Diamond (2s. 6d.)..... | 250 | 160 | 152 |
| Sheba (5s.)..... | 5 | 5 | 4 |
| Transvaal Gold Mining Estates..... | 52 | 38 | 37 |
| WEST AFRICA: | | | |
| Abbotiakoona (10s.)..... | 6 | 7 | 8 |
| Abosso..... | 17 | 13 | 14 |
| Ashanti (4s.)..... | 16 | 16 | 16 |
| Broomassie (10s.)..... | 7 | 2 | 2 |
| Prestea Block A..... | 12 | 13 | 15 |
| Taquaah..... | 16 | 15 | 15 |
| WEST AUSTRALIA: | | | |
| Associated Gold Mines..... | 7 | 7 | 7 |
| Associated Northern Blocks..... | 19 | 7 | 7 |
| Bullfinch..... | 15 | 7 | 6 |
| Golden Horse-Shoe (£5)..... | 53 | 45 | 43 |
| Great Boulder Proprietary (2s.)..... | 12 | 14 | 14 |
| Great Boulder Perseverance..... | 2 | 2 | 2 |
| Great Fingall..... | 8 | 9 | 9 |
| Ivanhoe (£5)..... | 57 | 52 | 50 |
| Kalgurll..... | 40 | 37 | 36 |
| Sons of Gwalia..... | 19 | 25 | 23 |
| Yuanmi..... | 8 | 3 | 3 |
| OTHERS IN AUSTRALASIA: | | | |
| Blackwater..... | 20 | 16 | 16 |
| Consolidated Gold Fields of N.Z..... | 10 | 13 | 13 |
| Mount Boppy..... | 12 | 13 | 10 |
| Mount Morgan..... | 66 | 50 | 52 |
| Progress..... | 7 | 11 | 10 |
| Talisman..... | 35 | 37 | 33 |
| Tasmania Gold (10s.)..... | 1 | 2 | 2 |
| Waihi..... | 40 | 45 | 42 |
| Waihi Grand Junction..... | 20 | 25 | 25 |
| AMERICA: | | | |
| Alaska Treadwell (£5)..... | 155 | 156 | 162 |
| Buena Tierra..... | 17 | 15 | 15 |
| Butters Salvador..... | 47 | 20 | 20 |
| Camp Bird..... | 14 | 10 | 9 |
| Casey Cobalt..... | 40 | 13 | 13 |
| Cobalt Town Site..... | 58 | 33 | 32 |
| El Oro..... | 15 | 12 | 14 |
| Esperanza..... | 17 | 17 | 15 |
| Granville..... | 11 | 10 | 10 |
| Kirkland Lake Proprietary..... | — | 73 | 74 |
| Mexico Mines of El Oro..... | 110 | 95 | 97 |
| Oroville Dredging..... | 5 | 11 | 10 |
| St. John del Rey..... | 15 | 16 | 15 |
| Santa Gertrudis..... | 20 | 12 | 11 |
| Tomboy..... | 26 | 21 | 22 |
| Tough-Oakes..... | — | 22 | 28 |
| RUSSIA: | | | |
| Lena Goldfields..... | 57 | 33 | 43 |
| Orsk Priority..... | 15 | 8 | 7 |
| Siberian Proprietary..... | 5 | 4 | 3 |
| INDIA: | | | |
| Champion Reef (2s. 6d.)..... | 10 | 11 | 11 |
| Mysore (10s.)..... | 107 | 96 | 93 |
| Nundydroog (10s.)..... | 24 | 26 | 27 |
| Ooregum (10s.)..... | 18 | 23 | 23 |
| COPPER: | | | |
| Anaconda (£5)..... | 135 | 131 | 126 |
| Arizona (5s.)..... | 38 | 36 | 36 |
| Cape Copper (£2)..... | 115 | 57 | 60 |
| Chillagoe (10s.)..... | 1 | 1 | 1 |
| Cordoba (5s.)..... | — | 7 | 6 |
| Great Cobar (£5)..... | 38 | 3 | 3 |
| Great Fitzroy (5s.)..... | 1 | 1 | 1 |
| Hampden Cloncurry..... | 40 | 27 | 27 |
| Kyshtim..... | 60 | 56 | 55 |
| Messina (5s.)..... | 29 | 22 | 15 |
| Mount Elliott (£5)..... | 95 | 53 | 55 |
| Mount Lyell..... | 23 | 25 | 23 |
| Rio Tinto (£5)..... | 1440 | 1387 | 1355 |
| Sissert..... | 20 | 25 | 25 |
| South American Copper (2s.)..... | 34 | 26 | 22 |
| Spassky..... | 65 | 52 | 52 |
| Tanayik..... | 51 | 72 | 78 |
| Tanganyika..... | 40 | 36 | 40 |
| Tharsis (£2)..... | 135 | 127 | 125 |
| Whim Well..... | 15 | 5 | 3 |
| LEAD-ZINC: | | | |
| BROKEN HILL: | | | |
| Amalgamated Zinc..... | 29 | 28 | 28 |
| British Broken Hill..... | 38 | 38 | 36 |
| Broken Hill Proprietary (8s.)..... | 35 | 37 | 36 |
| Broken Hill Block 10 (£10)..... | 27 | 34 | 32 |
| Broken Hill Block 14 (25s.)..... | 6 | 7 | 6 |
| Broken Hill North..... | 45 | 54 | 52 |
| Broken Hill South..... | 157 | 177 | 175 |
| Sulphide Corporation (15s.)..... | 27 | 26 | 26 |
| Zinc Corporation (10s.)..... | 17 | 21 | 19 |
| ASIA: | | | |
| Burma Corporation..... | — | 29 | 28 |
| Russian Mining..... | 8 | 35 | 31 |
| Russo-Asiatic..... | — | 152 | 151 |
| TIN: | | | |
| NIGERIA: | | | |
| Bisichi..... | 20 | 11 | 8 |
| Jos (5s.)..... | 7 | 5 | 5 |
| Kaduna (5s.)..... | 20 | 17 | 15 |
| Naraguta..... | 36 | 25 | 17 |
| N. Nigeria Bauchi (10s.)..... | 5 | 4 | 3 |
| Rayfield..... | 24 | 7 | 5 |
| Ropp..... | 147 | 117 | 100 |
| OTHER COUNTRIES: | | | |
| Aramayo Francke..... | 34 | 33 | 31 |
| Briseis..... | 8 | 4 | 5 |
| Cornwall Tailings..... | 25 | 17 | 17 |
| Dolcoath..... | 17 | 12 | 11 |
| Geevor (10s.)..... | 17 | 7 | 5 |
| Gopeng..... | 32 | 32 | 27 |
| Mawchi..... | 20 | 23 | 20 |
| Pahang Consolidated (5s.)..... | 9 | 9 | 7 |
| Renong Dredging..... | — | 52 | 36 |
| Tekka..... | 60 | 57 | 55 |
| Tronoh..... | 67 | 30 | 26 |

PRECIS OF TECHNOLOGY

Persian Oilfields.—In our last issue we recorded that the British Government had acquired control of the Anglo-Persian Oil Company, with a view to obtaining a regular supply of oil-fuel for the Navy. Before the deal was concluded, the Admiralty authorities appointed a Commission whose duty it was to examine the oilfields and the refineries of the company. The technical members of the Commission were John Cadman, professor of mining in the Birmingham University, and E. R. Blundstone and E. H. Pascoe, both geologists. The report made by this Commission has been published by the Government, and from it we extract the following information. The exclusive licence to drill for oil throughout the Persian empire, with the exception of the northern provinces immediately adjoining Russia, was granted to W. K. D'Arcy in 1901. These rights were transferred in 1909 to the

tun occur in the Fars series of rocks, which correspond to the Miocene of Europe. Mr. Lister James has divided the series into Upper Fars and Lower Fars, the latter being subdivided into (1) Passage Beds, (2) Gypsiferous stage with a band of calcareous sandstone in the middle, and (3) Lower Limestone. The highest petroliferous zone is 1000 ft. above the base of the Upper Fars, and the lowest horizon tapped in the wells is 1000 ft. below the top of the Lower Limestone, the total range of possible petroliferous beds being about 3000 ft. The Lower Limestone contains thick beds of a cavernous or cellular structure, and appear to be detrital in origin. The total thickness of these beds is not determined, as the base is not visible. The Gypsiferous series consists of 800 ft. of soft beds, alternately gypsum and red clay. The Passage Beds, 350 ft. thick, are similar to the Upper Fars, but contain thin beds of gypsum. The Upper Fars are composed of sandstones and shales, the latter containing



MAP TO SHOW POSITION OF PERSIAN OILFIELDS.

Anglo-Persian Oil Company, which was formed for the purpose. Lord Strathcona was chairman of the company, and the greater part of the ordinary shares were subscribed by the Burma Oil Company, which also guaranteed the interest on the preference shares. The concession covers half-a-million square miles, of which only a very small portion has been examined so far. Oil has been found in quantity at Maidan-I-Naphtun, and it has been proved at Kasr-I-Shirin; these two localities are marked on the accompanying map. Indications have been observed at White Oil Springs, a short distance to the south of Maidan-I-Naphtun, at Daliki, between Bushire and Shiraz, and at a number of places near the entrance to the Persian Gulf. The company's production comes entirely from Maidan-I-Naphtun, and the oil is sent by pipe-line, a distance of 140 miles, to Abadan at the head of the Persian gulf, where the refinery has been erected. The Persian oilfields have been examined by numerous geologists of standing with special experience in petroleum matters, H. T. Burls, W. H. Dalton, E. H. Cunningham Craig, Basil F. Macrorie, and S. Lister James.

The principal petroliferous zones at Maidan-I-Naph-

tun occur in the Fars series of rocks, which correspond to the Miocene of Europe. Mr. Lister James has divided the series into Upper Fars and Lower Fars, the latter being subdivided into (1) Passage Beds, (2) Gypsiferous stage with a band of calcareous sandstone in the middle, and (3) Lower Limestone. The highest petroliferous zone is 1000 ft. above the base of the Upper Fars, and the lowest horizon tapped in the wells is 1000 ft. below the top of the Lower Limestone, the total range of possible petroliferous beds being about 3000 ft. The Lower Limestone contains thick beds of a cavernous or cellular structure, and appear to be detrital in origin. The total thickness of these beds is not determined, as the base is not visible. The Gypsiferous series consists of 800 ft. of soft beds, alternately gypsum and red clay. The Passage Beds, 350 ft. thick, are similar to the Upper Fars, but contain thin beds of gypsum. The Upper Fars are composed of sandstones and shales, the latter containing

numerous veins of selenite; their thickness is estimated at 6000 ft. The rocks in the other oil districts are also of the Fars age, but no exact determination has been made. Flexures of considerable extent have been observed in all the districts examined by the Commission, revealing structures suited to the accumulation of petroleum. At Maidan-I-Naphtun, there appears to be one large anticline, which has been puckered into several minor folds with a predominant direction northwest by southeast. The area in which petroleum may be expected to be found is estimated at $3\frac{1}{2}$ square miles. The principal oil horizon lies at depths of from 1200 to 1300 ft., and as the oil is in a hard porous limestone the production ought to be steady, with little necessity for cleaning the wells. Thirty wells have been drilled, but only 12 have been carried down to the oil horizon. All the 12 have produced oil. Several of the wells have been capped, as their production is not at present required.

The storage capacity at Maidan-I-Naphtun is 60,000 tons. The oil is conveyed by pipe-line to Abadan, the fall being 800 ft. For the first 53 miles the pipe is 6 in. diameter and thence 8 in., the plan being to connect a branch line from White Springs if the borings

are successful. The delivery through the 8 in. pipe is estimated at 1000 tons per day. The refinery contains four benches, consisting in all of 34 stills, and petrol, kerosene of two qualities, and oil-fuel are produced. The last-named forms 65 to 70% of the total oil, and it can be produced, in a simple manner, of a quality suited to Admiralty requirements. It should be stated here that the oil fuel is used for burning under steam-boilers, and not in internal-combustion engines.

Earth Tremors on the Rand.—At the April meeting of the Chemical, Metallurgical, and Mining Society of South Africa, H. E. Wood, of the Union Observatory, read a paper on earthquakes and earth tremors as recorded in South Africa, especially on the Rand. He differentiated between the true earthquake, which is a deep-seated movement of the earth felt over a great tract of country and lasting for many minutes, and short sharp tremors caused by local movements of rock comparatively near the surface and caused by mining or pumping operations. South Africa has been singularly free from true earthquakes. The African regions of seismic activity are Algeria, and the region of the Great Lakes and Abyssinia. An earthquake however was recorded on February 20, 1912, the centre of which was near the southern border of the Orange Free State, in the neighbourhood of Koffyfontein and Jagersfontein. It was sufficient to cause damage to buildings within an area of 5000 square miles and to be felt over an area of 100,000 square miles. The Johannesburg seismographs indicated extensive oscillations of the earth, continuing for 20 minutes, yet the movement was noticed by few people on the Rand. On the other hand, local earth tremors have been plentiful of late years on the Rand. It was in 1908 that their occurrence was sufficiently frequent to attract sustained attention, and since then records have been kept. Their number has increased from 7 in 1908 to 82 in 1913. The seismographs show that their origin is local, and the movements to be of the single-wave type, a single jerk of the needle being the sole indication. Mr. Wood's experience goes to show that these tremors are caused by restricted movements of comparatively small masses of rock, and that their ultimate origin is the extraction of large amounts of rock and water during mining operations. The combined effect of ore-extraction and pumping is to divide the ground beneath the surface into small sections, which may be subdivided further by existing faults. These small sections become gradually unstable owing to the withdrawal of their supports, and suddenly slip by small amounts into positions of greater stability. This slipping communicates a slight jar to the surrounding ground, and the effect is radiated as a single wave of small amplitude. It is noteworthy that the shocks are felt in greater number along the central and eastern Rand than in the western Rand. The extraction of rock is naturally supposed by the miner to be the chief cause of these movements, but Mr. Wood also emphasizes the point that the withdrawal of water is an important factor. He instances the case of the town of Sunderland in the north of England, where in the years 1883 to 1885 numerous earth tremors were felt. Professor Lebour made investigations, and reported that the town stood on magnesian limestone of the Permian age, which is honeycombed with cavities of every size and shape. The water filling these cavities was pumped for the use of the town, and the roofs of the cavities losing their support were continually collapsing.

In the discussion following the reading of the paper, Alexander Richardson said that the tremors were by no means always referable to fault-planes. He in-

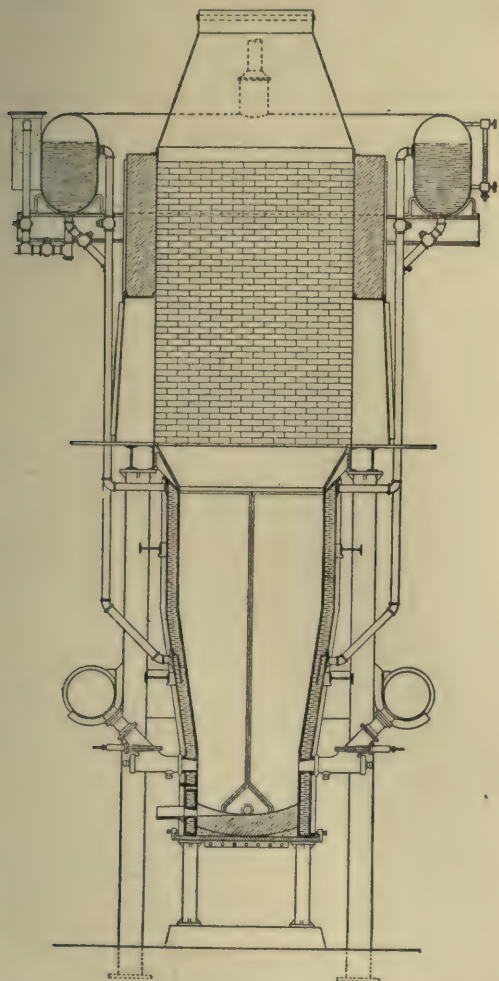
stanced a case six years ago when the residents in the Cleveland district were wakened during the night by a sharp shock. It was feared that a large stoped area had collapsed, but on inspection no such happening was found to have taken place. Subsequent diligent search revealed a crack, just wide enough to admit a match, in the hanging wall of one of the stopes at a depth of 1200 ft. and reaching from level to level for a distance of 300 ft. The formation of this crack was not associated with any fault and was not accompanied by subsidence, but it was sufficient to cause the severe tremor felt.

On the other hand A. C. M. Sim attributed many of the tremors to a line of fissure that is a conspicuous feature in the Village Main Reef mine. This line of fissure has caused an unusual fault through the three 'reefs' in this mine and is unlike the ordinary faults along the Witwatersrand Series. After passing the Village Main Reef, it goes through Lower Doornfontein, and through the Bezuidenhout valley, south of Bedford farm. The fissure runs diagonally across the 'reef' and up the valley, and the whole of the Hospital Series rests on it. As the ground settles from time to time, the people living to the north or northwest of the fissure will feel the shock, but those on the southeast will feel little of it.

Origin of Rand Gold.—As we have already mentioned, C. Baring Horwood has contributed a series of articles to the *Mining and Scientific Press* on the Rand blanket. As regards the origin of the gold in the blanket, Mr. Horwood has argued in favour of the infiltration theory. Much interesting discussion by eminent geologists of Mr. Horwood's articles has been published by our contemporary. Of these contributions, by far the most important is that by E. T. Mellor (in the issue of May 6), who, during the last four years in his capacity as Government Geologist, has been investigating the deposits throughout the length of the Rand. Mr. Mellor states that he started his investigations with a mental inclination toward the infiltration theory, but during his four years' work has not obtained any evidence in favour of the theory. On the contrary he found much evidence in favour of a placer origin. He states that those who compare the evidence in favour of the two theories will note that while the arguments for the placer theory are for the most part of a simple character, based upon direct observation of and comparison with similar deposits about the origin of which there can be no doubt, those in favour of the infiltration theory are frequently highly speculative or theoretical. That there has been considerable local redistribution of the gold content of the 'reefs' no one acquainted with them will be inclined to doubt. In many cases the redistribution has naturally produced effects which, though purely secondary, are suggestive of an infiltration origin for the whole deposit. The local character of some of these effects is often strikingly shown. With regard to the influence of dikes, Mr. Mellor says that against the few examples of such intrusions being associated with specially rich portions of the gold-bearing beds cited by Mr. Horwood, must be set dozens of examples in which either entirely opposite conditions are found or where nothing unusual is to be noticed. Though Mr. Mellor in his investigations has paid special attention to this point, he has not met with any instance where the presence of richer 'reef' was clearly dependent on the intrusion of a dike except as a purely secondary and extremely local result. He found several instances where the accidental disposition of a dike with regard to a rich patch at sight suggested a causal relationship, but further examination

never confirmed this view. Mr. Mellor is at present completing his report on the geology of the Rand. This report will contain his views in detail as to the origin of the gold and the data on which they are founded.

Nesmith's Water-Jacket.—In *Metallurgical and Chemical Engineering* for June there is a description of the Nesmith water-jacket which is intended for use in copper and lead blast-furnaces. Hitherto it has



been customary in water-jackets to pass the water through without vaporizing it, in fact care is taken that it shall not reach the boiling point. The idea is also prevalent that the colder the water is fed the greater the efficiency. A new departure has been made by the Colorado Iron Works, the owners of the Nesmith patent, in that the water is kept as hot as possible and the latent heat of steam utilized. The result is that far less water is required, an important consideration in many places. The heat required to transform water at 212° F. into steam at the same temperature is 966 British thermal units. Raising feed-water at 62° to 212° without vaporizing absorbs 150 units. Raising to this temperature and also vaporizing it absorbs 966+150, or 1116 units. It is thus seen that by the vaporizing water-jacket only one-eighth of the

water will be required, as compared with the ordinary jacket. It is notable also that far less strain is put on the iron or steel structure of the jacket by maintaining a more uniform and higher temperature. The accompanying drawing shows the design of the jacket. The vaporizing is done in a drum, which surrounds the jacket. The arrangement of the feed and connecting pipes is such that an efficient circulation is maintained. An automatic float-valve controls the admission of the feed-water, and an escape-pipe delivers the steam to the atmosphere. The writer of the article quotes the experience at a copper smelter not named to the effect that the consumption of water is 0.00362 gal. per square foot of jacket area. At Cananea with ordinary jackets the consumption is 0.616 gal. and at Granby 0.31 gallon.

Kirkland Lake Ores.—In our issue of September last year, we gave a précis of a paper by Reginald A. Hore, describing the orebodies at Kirkland Lake, Ontario. J. B. Tyrrell referred to the orebodies and geology in a paper read in December before the Institution of Mining and Metallurgy. Further information as to the minerals contained in the ore are given by Mr. Hore in the *Canadian Mining Journal* for April 15 and by Charles Spearman in the issue of the same paper for May 15. Mr. Hore states that the gold is found in narrow quartz veins and in the surrounding fractured porphyry rock. The vein material is of high grade and much of the ore has been sorted and shipped for treatment. The gold occurs native and as tellurides, but the latter are of little commercial importance. The native gold can often be detected by the naked eye, and frequently it is associated with and apparently deposited on a soft black substance that contains molybdenite. The black substance occurs commonly as a coating on the fractured surfaces of the quartz and country rock. Silver occurs both with the native gold and in the tellurides.

Mr. Spearman, in his article, describes a series of petrographic investigations of the ore by aid of the microscope and discusses the paragenesis of the constituent minerals. Eleven microphotographs are presented. These show gold and altaite encased in pyrite crystals. In the fractures of the quartz are native gold and tellurides of lead, zinc, silver, and gold. Pyrrargyrite, the sulphide of silver and antimony, is found frequently. Molybdenite is found associated with pyrrargyrite in dark bands along fractures in the quartz and it is also found as isolated particles in the quartz. No argentite has so far been recognized. Occasionally throughout the ore, calcite occurs as a secondary mineral. Dark wavy bands of the metallic minerals are characteristic of the ore. Some of the photographs indicate the severe pressure to which the quartz has been subjected after deposition. Two series of fractures are seen at about right angles and some others in intermediate directions. The fractures are often filled with later quartz. One of the slides shows massive pyrite, with borders of delicate radiating aggregates, enclosed within calcite. Another shows pyrite within quartz, and gold within the pyrite. Other slides give information relating to the nature of the auriferous porphyry country-rock.

In summarizing the results of his investigations Mr. Spearman says that every indication points to the conclusion that the gold and the tellurides were the first of the metallic constituents to be deposited. They are closely associated and bear evidence of contemporaneous origin. Pyrite, appearing at several stages in the history of the deposits, had its initial introduction immediately after the gold and tellurides. Frequently the gold and tellurides are found encased in pyrite

crystals. This is not the usual order of occurrence, as usually the gold deposition is induced by the pyrite, for instance, in the Porcupine district where gold is often found as a coating, on the faces of pyrite crystals. Although little native gold is found in actual contact with the pyrite in the Kirkland Lake district, it being nearly always found with the tellurides, or in isolated particles, yet it is an interesting fact that wherever pyrite is found in the impregnated zone, gold is found also, and the smaller the pyrite crystals, the higher the assay. This rule holds good also for the type of deposit within the porphyry. Next in succession come pyrrargyrite and molybdenite, so closely associated and bearing so similar relationship to the minerals already deposited that it is difficult to determine their respective order. In the sections examined, pyrrargyrite appeared to be more abundant than the molybdenite. Both being in a very fine state of division, the hand specimen is apt to be misleading, giving the whole the aspect of being impregnated with molybdenite. It was commonly supposed that molybdenite acted as a precipitant of the gold, and its presence therefore was invariably regarded with favour, but the order of succession above outlined does not bear out this supposition.

With subsequent shearing and fracturing of the deposit, due to strains caused by certain movements, quartz and sometimes calcite was later introduced into the many almost microscopic as well as the larger fractures. One of the photomicrographs shows what resembles pyrite replacing calcite. This occurs in a crushed zone, and calcite fills the voids in the breccia. Evidently, later solutions carrying pyrite replaced the calcite, showing a still later introduction of pyrite. No trace of gold or silver bearing minerals or molybdenite was found associated with this introduction. In another slide, calcite and pyrite are found together, and in a third pyrite appears as a primary mineral in the porphyry.

The Murex Process at Clausthal.—In the *Mining and Scientific Press* for June 6, James M. Hyde describes the application of the Murex process for separating finely divided galena from barite at the Wohlfahrt mine near Clausthal, Germany. We gave particulars of this process in our issue of October 1909, and more recently, in July 1913, we described its progress at the Whim Well copper mine in West Australia. The ore raised at the Wohlfahrt mine is divided into three classes: (1) black ore, which is a mixture of dark schist and galena; (2) white ore, which consists of barite, schist, quartz, and galena, and is difficult to concentrate owing to the intimate intermixture of quartz and galena and requires very fine grinding; (3) spathic iron ore containing galena in spathic iron with quartz and barite. Much slime is formed in connection with the concentration of all three classes, and also a fine sand middling, both containing much barite, and not amenable to any other method of concentration than the Murex process. The slime contains 10 to 11% lead and is high in silver; and the fine sand averages 4 to 7% lead. There are large accumulations of these two products. The feed for the Murex plant is composed of 33 to 40% of slime and 60 to 70% of fine sand. It is delivered to a trough mixer together with an equal weight of water, and thence passed to a barrel similar to a tube-mill and containing small pebbles, in which any rough balls of dried slime are broken and a uniform pulp produced. The pulp is then mixed with oil, pitch, and finely ground magnetite, and sent to an oiling-barrel, where the galena and magnetite are oiled and agglomerated into a condition suitable for the action of electro-magnets. The

oiling-barrel is 1·2 metres in diameter and 3·5 metres long. It is made of sheet-iron lined with beechwood blocks, and revolves on its horizontal axis at 20 r.p.m. To thoroughly mix the materials, small flint gravel and iron shot or screen punchings are added. The punchings become coated with the oily mixture and assist in oiling the galena; while the gravel is useful in keeping the thick charge open and flowing. The best temperature for the process is from 17 to 20° C. The feed averages 6 to 8% lead, and a concentrate averaging 56 to 62% lead is obtained, the tailing averaging 1·1% lead. A tube-mill is to be installed for the purpose of re-grinding the middling, whereby a better recovery will be made. Mr. Hyde gives useful details as to the amounts of material used and the cost. The oiling-barrel contains 150 kilograms of iron shot or screen punchings from 4 to 6 mm. in diameter and 150 kg. of flint pebbles from 10 to 20 mm. in diameter. The monthly consumption is about 5 kg. of iron and 5 to 10 kg. of pebbles. In treating 9000 kg. of slime and sand mixture per day, 20 kg. of paraffin oil, 40 kg. of pitch, 0·2 kg. of resin, and 72 kg. of finely ground magnetite are used. The cost delivered per 1000 kg. of these materials is: paraffin oil 140 marks, pitch 115 marks, resin 320 marks, and ground magnetite 41 marks. The cost of labour is reported at 0·98 mark per 1000 kg. of ore, and the cost of power 0·4 mark. The total cost per 1000 kg. is only 2·45 marks, or about 2s. 4d. per short ton. This is only a small installation and works one shift per day. A much larger plant would require no more labour, so on an extended scale the cost per ton would be considerably less, seeing that in the above figures labour accounts for 35% of the cost.

Flotation at Butte, Montana.—In the *Mining and Engineering World* for June 6, Jesse E. Cohn describes the concentration plant at Timber Butte, which has been erected for the treatment of the zinc-lead-iron sulphide ore at the Elm Orlu mine belonging to W. A. Clark. This plant is notable, as it constitutes one of the first applications of the Minerals Separation flotation process in America. The ore averages 20% zinc, 1½% lead, 2½% iron, 0·8% copper, 7 to 8 oz. silver, and 20 to 80 cents gold per ton. The scheme of treatment is to produce a high-grade zinc concentrate and lead and lead-iron concentrates. The capacity is 400 tons per day, and it is contemplated to eventually increase it to 1600 tons per day. In the first stage of treatment, jigs have been eliminated, and these machines are used only in re-treating lead-iron-zinc middling. The ore is crushed in Symons crushers and Garfield rolls to 2½ millimetre size, and treated on 8 Wilfley tables. The tailing from these tables is de-slimed in two 45 in. Aikens classifiers, and then ground to 20-mesh in Hardinge conical mills 8 ft. diameter by 30 in length of cylindrical portion, and passed over 8 James tables. The tailing from the James tables is de-slimed in Aikens classifiers, and the sand product is ground in Hardinge mills to from 40 to 60 mesh, afterward being delivered to the primary flotation plant. The tailing from the flotation plant is sent to Aikens classifiers; the sand portion is returned to the mills for re-grinding, and the slime and fine-sand overflow after dewatering in a Dorr machine is sent to the dump. The concentrate produced in the primary flotation plant is sent to the secondary plant for re-treatment, and the coarse tailing returned for re-grinding. The flotation concentrate is re-ground and the coarse portion sent over 8 James tables with the object of removing lead and iron as a lead concentrate and lead-iron middling. The latter joins the lead-iron middling produced from the first two stages

of table-concentration, and is classified, and the coarse portion treated over two jigs and three tables to remove iron and lead from the zinc, while the slime overflow is thickened and returned to the first flotation plant along with the product from the second stage of grinding. It will be seen that according to this scheme no exhausted tailing is produced on the tables, but that everything is re-treated by flotation.

Copper Production of the World.—The *Engineering and Mining Journal* for June 20 gives its final figures for the production of copper in the United States and the world. The figures for the United States, Canada, Mexico, and Cuba are based uniformly upon reports received from the several producers and represent the smelters' output, which is a different thing from either the mine output or the refinery output. In the case of the Michigan production, however, the smelters are also refiners, and their figures for smelting and refining productions are consequently the same. The figures that are now presented are the revision of preliminary figures, published last January. The alterations, either in total or in details, are insignificant.

The system of collecting the statistics from the smelters of North America makes it possible to arrive at the totals not only for the United States, but also for Canada, Cuba, Chile, Peru, and Mexico. The details of the production in Chile and Peru are also given. In computing the world's production of copper, the *Journal's* own figures are used for the United States, Canada, Cuba, Chile, Mexico, and Peru; the official statistics are used for Russia, and the statistics of Henry R. Merton & Co. for the other countries.

In the issue of January 10, 1914, the *Journal* reported the world's production of copper as having been 1,000,716 tons in 1913, which now appears to have been about 0.52% too low. Aron Hirsch & Sohn, of Halberstadt, have since then reported 1,009,091 metric tons, and Henry R. Merton & Co., of London, 1,002,157 metric tons. The *Journal's* revised total is 1,005,978 metric tons.

SMELTERS' PRODUCTION OF COPPER IN THE UNITED STATES

| (In Pounds). | | |
|----------------------|---------------|---------------|
| State | 1912 | 1913 |
| Alaska | 32,602,000 | 24,452,000 |
| Arizona | 357,952,962 | 399,849,745 |
| California | 31,069,029 | 32,390,272 |
| Colorado | 7,502,000 | 7,670,090 |
| Idaho | 5,964,542 | 8,434,028 |
| Michigan | 231,628,486 | 159,437,262 |
| Montana | 309,247,735 | 285,336,153 |
| Nevada | 82,530,608 | 84,683,961 |
| New Mexico | 27,488,912 | 46,953,414 |
| Utah | 131,673,803 | 147,591,955 |
| Washington | 1,121,109 | 448,805 |
| East and South | 18,592,655 | 24,333,014 |
| Other States | 4,396,667 | 4,155,135 |
| Total | 1,241,770,508 | 1,225,735,834 |

SMELTERS' PRODUCTION OF COPPER IN NORTH AMERICA

| (In Pounds). | | |
|---------------------|---------------|---------------|
| Country | 1912 | 1913 |
| United States | 1,241,762,508 | 1,225,735,834 |
| Canada | 75,425,575 | 76,796,586 |
| Mexico | 162,295,545 | 128,579,656 |
| Cuba | 9,684,934 | 7,453,805 |
| Total | 1,489,168,562 | 1,438,565,881 |

SMELTERS' PRODUCTION

| (In Pounds). | | |
|-----------------------------|---------------|---------------|
| Source | 1912 | 1913 |
| N. American ore..... | 1,489,168,562 | 1,438,565,881 |
| Foreign ore..... | 53,701,307 | 55,803,202 |
| Scrap | 11,949,348 | 22,427,889 |
| Total | 1,554,719,217 | 1,516,796,972 |
| To foreign refiners.. | 45,735,673 | 36,682,605 |
| To American refiners | 1,508,983,544 | 1,480,114,367 |
| Crude copper imported | 144,480,144 | 169,315,869 |
| Total crude copper | 1,653,463,688 | 1,649,430,236 |

WORLD'S PRODUCTION OF COPPER

| (In Metric Tons). | | |
|-----------------------|-----------|-----------|
| Country | 1912 | 1913 |
| United States..... | 563,260 | 555,990 |
| Mexico..... | 73,617 | 58,323 |
| Canada | 34,213 | 34,880 |
| Cuba | 4,393 | 3,381 |
| Australasia | 47,772 | 47,325 |
| Peru..... | 26,483 | 25,487 |
| Chile..... | 39,204 | 39,434 |
| Bolivia..... | 4,681 | 3,658 |
| Japan | 62,486 | 73,152 |
| Russia | 33,550 | 34,316 |
| Germany..... | 24,303 | 25,308 |
| Africa | 16,632 | 22,870 |
| Spain and Portugal | 59,873 | 54,696 |
| Other countries | 29,555 | 27,158 |
| Total | 1,020,022 | 1,005,978 |

REFINERS' PRODUCTION

| (In Pounds). | | |
|-------------------|---------------|-----------------|
| Class | 1912 | 1913 |
| Electrolytic..... | 1,288,333,298 | 1,406,448,665 * |
| Lake..... | 231,628,486 | 159,437,262 |
| Casting..... | 24,777,266 | 22,606,040 |
| Pig..... | 37,181,237 | 33,958,862 |
| Total | 1,581,920,287 | 1,622,450,829 |

COPPER PRODUCTION OF CHILE

| (In Pounds). | | |
|-----------------------------------|------------|------------|
| | 1912 | 1913 |
| Blister copper to U.S..... | 8,627,421 | 18,315,000 |
| Copper in ore to U.S. | 27,445,679 | 24,911,465 |
| Copper to England and France..... | 50,136,800 | 43,460,480 |
| Sundries, estimated | 220,000 | 250,000 |
| Total, lb. | 86,429,900 | 86,936,945 |
| Total, metric tons | 39,204 | 39,434 |

COPPER PRODUCTION OF PERU

| (In Pounds). | | |
|-----------------------------------|------------|------------|
| | 1912 | 1913 |
| Blister copper to U.S..... | 43,891,439 | 42,667,436 |
| Copper in ore to U.S. | 11,373,009 | 10,089,592 |
| Copper to England and France..... | 2,900,000 | 3,180,800 |
| Sundries, estimated | 220,000 | 250,000 |
| Total, lb. | 58,384,448 | 56,187,828 |
| Total, metric tons | 26,483 | 25,487 |

Oil in Alberta.—A memoir by D. B. Dowling has been published by the Canadian Geological Survey, describing the district of Southern Alberta, where gas and petroleum have been found. This publication is particularly opportune, as it gives the geologic facts relating to a district that is being wildly boomed. The boring of the Petroleum Products Company on Sheep river, near Okotoks, has proved the presence of petroleum in the Belly River sandstone beds, which belong to the Cretaceous age, and there are traces of oil in the weathered face of these sandstones in outcrops on tributary creeks nearer the mountains.

Mr. Dowling quotes previous memoirs of the geological survey relating to the rocks of Southern Alberta prepared by D. D. Cairnes and Wyatt Malcolm. The following table gives the details of the Secondary and Tertiary rocks:

Tertiary.....Paskapoo series of Northern Alberta, or Porcupine Hill beds of Southern Alberta.

Cretaceous....Edmonton series of Northern Alberta or St. Mary River beds of Southern Alberta.

*Bearpaw shales, the equivalent of the Pierre shales east of the Alberta syncline.

Belly River series.

Claggett shales, the equivalent of the Lower Dark shales of Southern Alberta, or the lower part of the Pierre.

Cardium sandstones.

Niobrara-Benton shales.

Dakota sandstones.

Kootenay formation.

JurassicFerne shales.

The Macleod branch of the Canadian Pacific railway skirts the eastern edge of a belt of hilly country which lies to the east of the foot-hills proper. The rocks in these hills are of early Tertiary age and consist of light-coloured sandstones and clays, which are exposed in the vicinity of Calgary and westward, on the Bow river. In the district under discussion these beds are found in the hills west of Okotoks, and are there seen lying almost horizontally. To the west, up Sheep river, there are occasional exposures, and near the forks of the river the dip of the strata is to the east, thus showing the approach to the western edge of a syncline. The rocks beneath the heavy bedded sandstones such as are occasionally seen cropping on the sides of the hills, are apparently varicoloured shales and sandstones dipping eastward and are in evidence on the banks of the stream north of the post-office at Black Diamond. From beneath these comes a thick series of sandstones which a short distance farther west are tilted at higher angles, and as coal seams are found with them, they may be provisionally correlated with the Edmonton beds. As these latter sandstones are of a harder nature than the rocks above and below, their presence is indicated by a line of hills which cross the river valley and through which the two branches of Sheep river have cut channels. This line of hills marks the eastern side of a long fold running parallel to the mountains, and, at a short distance west, a similar ridge seems to be formed by the westerly dipping beds of the same series, thus indicating an anticline. The rocks exposed across this portion between the hills are dark coloured marine shales representing the Bearpaw or upper portion of the Pierre-Foxhill formations. The intercalated fresh and brackish water member, the Belly River series, comes very near the surface in the centre of the anticline. The

presence of a sandstone with markings resembling plants indicates a change in condition of deposition, but, according to the record of drilling operations on this anticline, shales continued for nearly 300 ft. before the sandstone series was reached. Westward of the sandstone rib on the west side of this anticline, a decided break or fault is indicated and lower beds have been brought up. These, both in thickness and composition, resemble the Bearpaw shales; but as at the top, overlain by black or brown shales, there occurs a sandstone member which is not to be found in the exposures of these shales to the east, it is concluded that they represent the Claggett series which is below the Belly River. Marine fossils have been collected from this series, but they are not of species definitely characteristic of any horizon. These shales overlies the Niobrara-Benton and the Dakota, but no exposures of either are here found, as the lowest beds of the anticline are shales of the same series. The axis of this anticline passes just to the west of Lineham ford. For some distance west, the shales continue with moderate westerly dips, but a broken zone is reached near the eastern boundary of section 33, in which there is considerable folding and the thin sandstones found in this shale series are repeated several times. This sandstone is probably the series called by Cairnes the Cardium sandstone, and it is expected that in places some oil may be obtained from it. The outcrops in places are stained with paraffin which can be detected only by treatment with a solvent such as chloroform, and in this way a trace of a heavy oil can also be obtained. A band of steeply inclined beds of Belly River sandstone is found just above the mouth of Macabee creek, and in these there are two horizons similarly stained with paraffin. One horizon at about the centre is supposed to represent the beds from which some oil was obtained in the well being drilled on section 6, township 20, range 2. The shales to the east of this series of sandstones may possibly be the Claggett, but as their thickness is considerable and the sandstones at the base resemble the top of the Belly River series rather than the Cardium sandstones, they are provisionally called Bearpaw.

CURRENT LITERATURE

Winding-Ropes on Drums.—The *Colliery Guardian* for May 29 reprints a paper by Hugh Bramwell read before the South Wales Institute of Engineers on the coiling of winding-ropes on drums.

Dust in Mines.—The *Iron & Coal Trades Review* for June 12 prints with comments a paper by W. A. Douglas Rudge, read before the Royal Society, describing the electrification caused in dust when suddenly raised into a cloud. It is considered that under some circumstances the potential may be high enough to cause a spark. The application of this paper to mining lies in the supposition that some explosions in coal mines may be caused in this way, even where stone dust has been sprinkled in the workings with the object of rendering coal dust non-explosive.

Ferro-concrete in Mines.—The *Colliery Guardian* for June 12 describes the ferro-concrete linings used at one of the coal-mines of the Gelsenkirchen company, Westfalia.

Hammer-Drills.—In the *Engineering and Mining Journal* for June 6, C. A. Bergman describes several hammer-drills used in Swedish mines.

Dredging in Russia.—In the *Mining and Scientific Press* for May 30, W. H. Shockley gives a translation of the official report on gold and platinum dredging in the Russian Empire during 1912.

NEW BOOKS

Hardness of Ores.—In the *Monthly Journal* of the Chamber of Mines of Western Australia for April, W. B. Blyth describes a method of testing the hardness of ores as applied to their behaviour in tube-mills.

Stebbins Dry Concentrator.—In the *Engineering and Mining Journal* for May 30, Fred A. Hale describes the operations of the Stebbins dry concentrating table, used on complex sulphide ore in the Yellow Pine district of Nevada.

Fine-Grinding in Tin Concentration.—In the *Mining and Scientific Press* for May 23, M. G. F. Sohnlein gives additional details relating to his application of grinding pans for the fine grinding of tin ore, used at Machacamarcá, Bolivia.

Burt Filter.—In the *Engineering and Mining Journal* for June 13, C. E. Rhodes and A. B. Myers describe the work of the Burt revolving pressure-filter used at the cyanide plant of the El Oro Mining & Railway Company, Mexico.

Flue-dust Losses.—In the *Mining and Scientific Press* for June 6, T. Neilson and L. Larson describe the method adopted at the Steptoe smelter for determining the loss of metals in flue-dust.

Aluminium in America.—In the *Engineering and Mining Journal* for June 13, Donald M. Liddell describes the projected works of the Southern Aluminium Company at Whitney, North Carolina. The reservoir will cover 8 square miles, and the power-house will generate 70,000 kilowatts. The alumina will be prepared from bauxite by the Bayer process, according to which the bauxite is treated by caustic soda to produce acid sodium aluminate. Eventually the Serpek process will be used, according to which aluminium nitride is formed from bauxite, and the nitride decomposed with the formation of alumina and ammonia.

Old Dominion Smelter.—In the *Engineering and Mining Journal* for June 6, Richard H. Vail describes present practice at the Old Dominion copper smelter at Globe, Arizona, giving details of the work of the new upright converter of the Great Falls type erected last year; the output of copper daily and per lining is remarkably high.

Chloridizing Copper-Nickel Ores.—In the *Engineering and Mining Journal* for May 30, A. H. Carpenter describes a process under investigation by the Pennsylvania Salt Co. for removing the copper from copper-nickel ores of Sudbury by chloridizing-roasting and leaching, and then smelting the residue for the production of an iron high in nickel. The object of this process is to avoid the waste of the iron in the ore as at present.

Cottrell Fume-Settler.—An article in the *Engineering and Mining Journal* for May 30 describes some of the recent applications of the Cottrell fume-settler.

Tin Assay.—In the *Engineering and Mining Journal* for June 6, R. L. Hallett gives his experience of the Pearce-Low method for the volumetric determination of tin.

Microscope in Rock-Study.—In the *Mining and Scientific Press* for June 6, James C. Ray writes on the application of the reflecting microscope in mining geology and metallurgy, recounting previous work and writings on the subject, and giving instructions for the preparation of specimens, the methods of identification of opaque minerals, and also a specific application of this method of study to the examination of ores at the Leonard mine, Butte.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

The Wilds of Maoriland. By James Mackintosh Bell.

Cloth, octavo, 252 pages, with illustrations and maps. London: Macmillan and Co. Price 15s. For sale at the Technical Bookshop of *The Mining Magazine*.

As Professor James Geikie has written lovingly on 'The Scenery of Scotland,' so this geologist, once the Director of the Geological Survey of New Zealand, writes affectionately concerning the mountainous islands at our antipodes. During the six years of his official service, Dr. Bell had a rare chance to penetrate into the less known and most picturesque portions of New Zealand, particularly that back country into which the aboriginal inhabitants, the Maoris, have retreated. He has used his opportunities with enthusiasm, the result being a book that is interesting and informing. We begin by going with him to the North Cape, visiting incidentally the gum settlements, namely, the localities where the digging of kauri gum is an important industry. This substance testifies to the former existence of mighty forests of the kauri, a noble tree which yields the gum that, in fossilized state, is now found three or four feet under the surface. The North island of New Zealand has yielded £16,000,000 worth of this substance up to the end of 1912, in which year the output was £401,305. The digging is done by Maoris and by Croats—a curious association of races. The Hauraki goldfields, with their strange vicissitudes of fortune, are given a chapter, which, however, is most appealing on its least technical side. The stories of the Maoris and their cannibal feasts, unpleasant evidence of which still survives in whitening bone and blackened fireplace, are a part of the local colour; the gum-diggers and prospectors that cross the geologist's trail provide an intensely human touch; and the luxuriant tropical foliage that blocks his passage through the bush provides subjects for his pencil. These hold our imagination more than the statistical data, although even they are not without an arid eloquence of their own.

The geologic record of New Zealand is punctuated by volcanic outbursts, decreasing in violence during the human period, but still a prominent factor not only in the topography but in the history of the inhabitants. The disastrous eruption of 1886 will be remembered, with its destruction of the famous pink and white terraces, and the actual death of 130 persons, mostly Maoris. Since then Nature has hastened to repair the effects of her violence, the marks of devastation being healed by the rapid growth of a beautiful vegetation. In contrast to the description of the volcanic outburst, we read of the native love for bathing in the warm pools near the hydrothermal vents that mark decaying vulcanism, and of the boon to a lazy people offered by the natural steam jets in which they can cook food. This chapter is beautifully illustrated by photographs and maps. Indeed, Dr. Bell has the good sense to furnish numerous maps, so essential to the reading of a book of travel. Here also we may refer to the water-colour sketches, some of them delightful, that adorn the volume. We suspect that they are the work of the gentle lady who accompanied her husband in his geological wanderings. They are a fitting accompaniment to the author's word-painting, which is vivid without splashing. From the semi-tropical vegetation of the North island, the author takes us to the noble fiords and grand glaciers of the South island. New Zealand covers an area slightly less than that of the British Isles, but it stretches through 12 degrees of latitude and rises to an altitude

of 12,349 ft.; hence a great diversity of climate and scenery. All of this is explained and illustrated by the author in his text and photographs, constituting the last chapter of the volume. We lay it aside with regret, and thanks. To those who have never been there, it will be a land to which they will hope to go when their ship comes home. To those who have been there it recalls the romance of the Maori, the vision of the cabbage-palm silhouetted against the snowfields, the perfume of the manuka, and the memory of a people we are proud to claim as our kinsmen.

T.A.R.

The Steel Foundry. By John Howe Hall. Cloth, octavo, 280 pages, illustrated. New York: McGraw Hill Book Co. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This volume deals chiefly with the commercial aspect of the steel foundry, setting forth the metallurgy "from the point of view of the engineer who keeps constantly in mind that his is a profession whose usefulness consists in prescribing the cheapest means of producing objects or structures of sufficient excellence for the purposes for which they are intended."

The general considerations governing the choice of a method of steel-making are reviewed, and the several modifications of the Bessemer, surface-blown, open-hearth, and electric processes considered in some detail, with their advantages and disadvantages for foundries doing varying types of business, particularly with reference to the cost per ton of steel castings produced. The figures and prices, of course, refer to American practice and the book will accordingly be chiefly of value in the United States, though the details of calculation for mixing by analysis to obtain metal of desired composition should be useful to all foundrymen.

The author speaks a little disparagingly of the "characteristic conservatism" of Sheffield steel-makers as evidenced by their preferring to melt blister bar for high-grade tool-steels, rather than a mixture of puddled iron and washed metal; but when it is borne in mind that the latter method is used in Sheffield to make very large quantities of crucible steel of not quite the best quality, and that a considerable proportion of that made from blister bar goes to America itself, their conservatism is to be understood.

Where costs, plant, and tonnage are dealt with the book is uniformly good, but in theoretical matters the statements are sometimes dogmatic with too slight a basis of actual fact. Some of the author's expressions, for instance: "phosphoric oxide is at once reduced by iron and carbon with the formation of FeO, CO, and metallic phosphorus," sound strange to English readers, though doubtless well understood in his own country.

The portion dealing with the other departments of the foundry, moulding, heat-treatment, annealing, and mechanical testing, is much less exhaustive than that dealing with making; indeed some expansion of this part of the book would be desirable.

The volume contains an index, many useful diagrams (chiefly reprinted), is well printed with the exception of a few typographical errors ('millenium' for 'millennium'; 59% for 0.59%), and is generally well up to the high standard of the McGraw-Hill Company. To sum up, the book is one that should be useful to those planning a new foundry or extending an old one, but it is hardly likely to supersede the existing treatises dealing with the everyday problems of a foundry in operation.

J. ALLEN PICKARD.

Minerals of the Black Hills, South Dakota. By Victor Ziegler. Octavo, paper covers, 250 pages, illustrated. Rapid City, South Dakota: The School of Mines.

This is a general mineralogy adapted specially for the study of the minerals in a region of unusual interest, scientifically and commercially. The Homestake mine is a celebrated producer of gold, while Harney Peak has been a disappointment in its tin. Mr. Ziegler, however, does not touch on commercial topics, but on the science of the minerals, which occur in great variety, many being rare and some unknown elsewhere.

Hand Sketching for Mine Students. By G. A. Lodge and N. Harwood. Cloth, foolscap, oblong size, 120 pages, fully illustrated. London: Crosby Lockwood & Son. Price 3s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The authors of this work are connected with technical schools in the coal districts in the north of England. Their object is to enable the student to make sketches by free-hand of the details of construction and at the same time to teach their uses and design.

Geological Excursions round London. By George MacDonald Davies. Cloth, octavo, 160 pages, illustrated. London: Thomas Murby & Co. Price 3s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book provides an outline of excursions within 80 miles of London to places of interest to the geologist. The ground covered is divided into three sections: the London basin, the Weald, and the Oolites and Lias of Oxfordshire and Buckingham. The book cannot be compared for quality or quantity with the 'Handbook of the London Geological Field Class' published in 1892, prepared by Professor Seeley and his students. Moreover it is not founded on recent personal observation. For instance, Copt Point, near Folkestone, once so famous for its Gault fossils, has lost its glory, owing to the ravages of the sea, and the visitor will be sorely disappointed if he undertakes the pilgrimage recommended by Mr. Davies.

Mines of Africa. By R. R. Mabson. Cloth, octavo, 680 pages, with maps and plans. London: *The Statist*. Price 21s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is the tenth edition of a guide to African mining companies, that has recently become a year-book. The author, Mr. Mabson, of *The Statist*, is not a mere compiler; he is an authority on the science of business and finance, and he has an intimate personal acquaintance with the Transvaal and Rhodesian mining districts. His book contains, in addition to the published records of each company, intelligent examinations of the mining conditions, costs, prospective lives, distribution of the gold in the several 'reefs,' etc. The maps and plans are helpful. The preface is a useful critical survey of the present position of mining in Africa and of the general outlook.

Tin Mining Handbook. By Hubert A. Meredith. Paper boards, pocket size, 330 pages. London: *The Financial Times*. Price 2s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This useful handbook has run through many editions during the year and a half since it was first published, and each succeeding issue has become more complete and authoritative. The scheme of the book is similar to the 'Mining Manual,' giving particulars of all the companies operating tin-mining properties.

COMPANY REPORTS

Tekka.—This company has headquarters at Redruth, Cornwall, and was formed in 1907 under the auspices of James Wickett to acquire the Sungei Raia alluvial tin property in the Kinta district of Perak, Federated Malay States. In 1910 property was purchased near Taiping, farther north in the same state, and it was transferred to a subsidiary, the Tekka-Taiping, in September last. The Tekka has been a successful venture and substantial dividends have been paid. The report for the year ended January 31 shows that production was checked at Sungei Raia owing to an accident at the intake works, which caused a diminished water-supply for three months, and the yield of black tin was 77 tons less than during the previous year, the figure being 358 tons, selling for £38,917. In addition, a profit of £3337 was made from the working of the Taiping property, where 137½ tons of black tin was won. The total profit was £22,954, and £13,439 was brought forward from the previous year, making a disposable balance of £36,393, out of which £24,000 has been distributed as dividend, being at the rate of 30%. The shareholders also received 20,000 shares in the Tekka-Taiping. The amount of gravel treated at Sungei Raia was 450,000 cu. yd., so that the yield was 1'78 lb. black tin per yard. The ground developed during the year is fully equal to the average, and the prospects are bright. At the Taiping property the yield was 1'37 lb. per yard; a bucket-dredge is being erected. Osborne & Chappel are the managers.

Lahat.—This company is stable-companion to the Tronoh, and was formed in 1906 to acquire from the same vendor a tin-gravel property at Lahat, in the state of Perak, Federated Malay States. The capital is £120,000, and dividends have been paid ranging from 8½ to 17½%. The output of black tin for the first year of operation, 1909, was 595 tons, a figure that has not been maintained. The report for the year 1913 shows that 381 tons was won from 284,676 cubic yards, being a yield of 3 lb. per yard. The yield per yard was ½ lb. less than during the previous year, the fall being entirely due to exceptional rains, which carried much barren sand and silt into the workings. The amount of overburden removed was 76,415 yards. More water has to be removed now than formerly, owing to springs having been uncovered, and the pumping plant has had to be extended. The old pumps are becoming inefficient, and an entirely new installation has been ordered. A new power-plant, consisting of a Diesel engine and electric generator, is also being erected. The income from the sale of black tin was £46,817, and £3504 was received from tributaries who worked the Sorokai section. The net profit was £6136, and £9343 was brought forward from the previous year, making a disposable balance of £15,480, out of which £10,500 has been distributed as dividend, being at the rate of 8½%. Oscar S. Dawbarn is manager.

English Crown Spelter.—This company was formed in 1883 to acquire zinc mines in the province of Bergamo, Italy, together with the smelting works at Swansea belonging to the Crown Zinc Co. The capital is £84,000, and dividends have been continuously paid, varying from 5 to 40%. The report for the year 1913 shows that 6858 tons of high-grade ore was raised, of which 4728 tons was carbonate and 2130 tons blende. In addition, 13,229 tons of low-grade ore was sent to the concentration plant, where 3600 tons of carbonate and 817 tons of blende were recovered. On calcining, the calamine ore yielded 3182 tons and the calamine concentrate 2437 tons of

material ready for the retorts. The average material, calcined carbonate and raw blende, shipped to Wales contained about 41% zinc. At the smelting works other ores were treated, and the total output of metal was 7194 tons. The profit for the year was £4044, which, added to the balance brought forward from 1912, made a disposable balance of £9375. Out of this, £8400 has been distributed as dividend, being at the rate of 10 per cent.

Mount Lyell Mining & Railway.—The operations at the copper mine of this company, in Tasmania, have once more become normal, after the interruptions of the last few years caused by the strike and the underground fire. The report for the half-year ended March 31 shows that at the Mount Lyell mine, 88,507 tons was raised from underground and 19,934 tons was taken from the open-cut. The amount of ore sent to the smelter was 103,420 tons, averaging 0'48% copper, 1'85 oz. silver, and 0'8 dwt. gold, and the ore despatched to the sulphuric and works was 5021 tons. At the North Lyell mine, 60,461 tons was raised, and 59,369 tons delivered to the smelter, averaging 5'9% copper, 1'24 oz. silver, and 0'1 dwt. gold. From the Lyell Comstock mine, 807 tons of ore was delivered to the smelter, averaging 3'84% copper, 0'28 dwt. silver, and 0'74 dwt. gold; the mining operations at this part of the property are expensive and work is at present being restricted in consequence. The amount of blister copper produced at the smelter was 3433 tons, containing 3391 tons copper, 231,740 oz. silver, and 4504 oz. gold. The ore reserve is estimated as follows: At the Mount Lyell 2,097,072 tons averaging 0'53% copper, 1'96 oz. silver, and 0'55 dwt. gold; at the North Lyell 1,025,651 tons averaging 6% copper, 1'33 dwt. silver, and 0'1 dwt. gold. Developments at the South and North mines have added to the prospective reserve. In particular, the ground at the boundary of the North and Comstock sections has been proved to contain excellent ore. The hydro-electric installation, utilizing the waters of Lake Margaret, is nearly completed, and should be at work by September. An experimental flotation plant has been erected and has given satisfactory results on Comstock ore. The accounts show an income from the sale of precious metals and of 3485 tons of copper amounting to £298,054, and a net profit of £61,954. The sum of £80,424 was distributed as dividend, being 1s. 3d. per £1 share.

Briseis Tin.—The report for 1913 of this company, operating tin-gravel mines in northeast Tasmania, shows that the richer portions of the property are mostly exhausted, and that the operations are now confined to the Northern and Krushka Flat sections. Owing to the scanty rainfall, the Ringarooma leases have not yet been actively developed, so that production from this source has been postponed. The fall in the price of tin is another adverse condition. The yield of black tin at the Northern section was 42'6 tons from 27,000 cubic yards, and from Krushka's Flat 421'5 tons from 248,000 cu. yd. At the Ringarooma lease, 38'9 tons was recovered from 286,000 cu. yd., and at the Mutual Hill property 11'65 tons was obtained from 47,000 cu. yd. The total production was 514'66 tons containing 74'6% metal. The Mount Bischoff company's smelting works at Launceston treated this output, for a return of 373'8 tons of tin, selling for £69,428, or £185 per ton, £30 per ton less than obtained during 1912. The working cost in Tasmania was £34,528, which is considerably higher than for 1912, the advance being due to a contraction of the scale of operations and the lower yield per yard. As regards the future, it is estimated that 600 tons of

black tin remains to be extracted from Krushka's Flat, and that at the Ringarooma lease the available black tin is 4549 tons to be won from nearly $7\frac{1}{2}$ million yards of drift. The company also owns the Wallace gold-gravel property in Victoria. The results have been disappointing during 1913, as the yield was only 4'12d. per yard, the gold won being £25,109, from 1,461,200 yards. The cost of dredging has been increased by advances in wages and price of wood-fuel, and totalled £20,467. The company's accounts also include £3352 for administration expenses, £4892 allowance for depreciation of plant and investments, £4158 for taxes, and £2361 as payment to the vendors of the gold-dredging properties. The shareholders received £30,000, being at the rate of 5 per cent. Lake & Currie are the consulting engineers, and Lindesay C. Clark is general manager.

Talisman Consolidated.—This company was formed in 1899 to acquire a gold-mining property in the Karangahake district of New Zealand. Several adjoining properties were subsequently purchased, including the Woodstock mine and mill, and the company was reconstructed in 1904. Dividends were first paid in 1906, and since then £909,407 has been distributed on a capital of £345,000, in addition to £53,695 being placed to reserve. Bewick, Moreing & Co. are the consulting engineers and managers, and H. Stansfield is superintendent. The report for the year ended February 28 last shows that the mine was idle the greater part of November and December owing to the non-delivery of coal during the strike. The company's own employees did not participate in this strike, which caused so much trouble elsewhere. During the 10 months of working, 41,680 tons of ore was raised and sent to the mill, where 52,703 oz. gold and 100,161 oz. silver were extracted, worth £224,297, or £5. 7s. 7d. per ton milled. The working cost was £98,005, or £2. 7s. per ton, in addition to which £7850 was allowed for depreciation of plant and £12,306 paid as taxes. The shareholders received £120,750, being at the rate of 35%. The shortness of fuel hindered development, but 31,540 tons of ore was disclosed, making the reserve on February 28, 37,513 tons averaging £5 5s. 6d. This reserve includes only the ore blocked-out on the 14th level and above; below this level and at one end of it are additional supplies of ore not sufficiently developed to warrant an estimate, though the results are decidedly satisfactory. Additional ground is to be purchased to the north of the Woodstock property, in the expectation that two of the lodes may dip out of the present boundary. The directors state that a compromise has been effected with the Moore Filter Company in connection with the latter's claim for infringement of the filter patents. The amount to be paid is comparatively small.

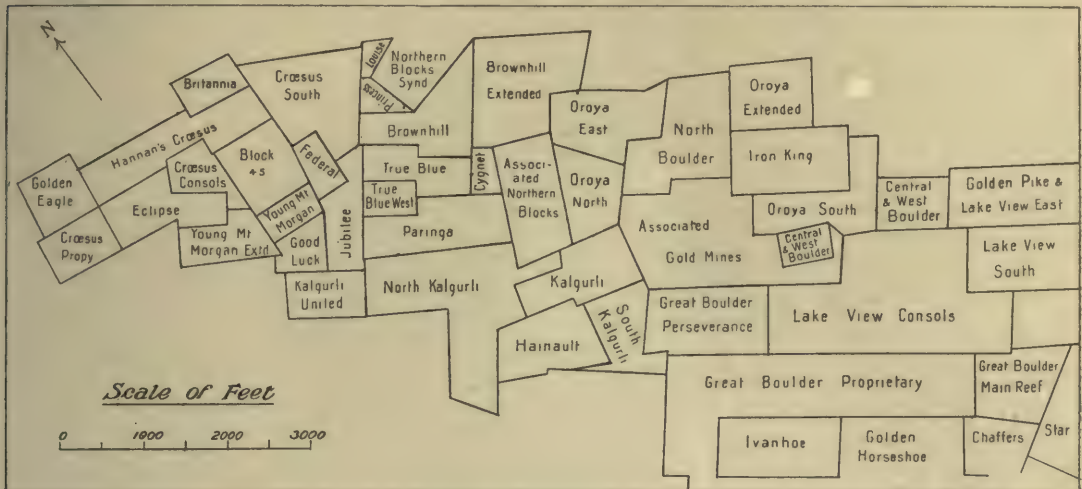
Zinc Corporation.—This company was formed in 1905 by Bewick, Moreing & Co. to purchase zinc tailing at Broken Hill and to treat it by the flotation process for the purpose of producing zinc concentrate. At first, the Minerals Separation process was used, but as good results were not obtained, the Potter process was tried. Neither did this give satisfaction, and finally the Elmore vacuum process was adopted. By its means the fortunes of the corporation were retrieved, and for some years, from 1908 to 1910, large amounts of tailing were profitably treated. In the meantime, however, the Minerals Separation process was perfected, and in 1910 it replaced the vacuum process. In 1911, the corporation purchased the South Blocks mine. The report for 1913 shows that 162,956 tons of ore was raised and sent to the concentrator, averaging 14'7% lead, 8'95% zinc, and 2'6 oz. silver

per ton. The yield of lead concentrate was 30,680 tons averaging 66'2% lead, 6'4% zinc, and 9'27 oz. silver, and 36,536 tons of zinc tailing, averaging 15'6% zinc, 5'1% lead, and 1'9 oz. silver. At the zinc concentrator, 350,120 tons of tailing was treated, of which 178,417 tons came from the purchased dumps, the remainder being current tailing from the British Broken Hill, the Broken Hill Junction, and the corporation's own mine. The yield of zinc concentrate was 102,850 tons averaging 44'2% zinc, 12'5% lead, and 12'1 oz. silver. By further treatment on tables, this was separated into 81,830 tons of zinc concentrate averaging 47'1% zinc, 7'7% lead, and 10'5 oz. silver, and 12,623 tons of lead concentrate averaging 55'4% lead, 15'4% zinc, and 31'8 oz. silver. There was produced also 4580 tons of concentrate by the Horwood selective process. A by-product at the zinc concentrator was 3442 tons of slime, which was stored for future treatment by the Horwood process. The Horwood and Lyster selection processes, recently described in our columns, have been established successfully at the corporation's plant. The report gives details of the developments at the South Blocks mine, and of the orebodies in the lead and zinc lodes; we have referred to these already in 'Review of Mining.' The ore reserve in the lead lode above the 7th level is estimated at 971,784 tons averaging 14'8% lead, 9'5% zinc, and 2'4 oz. silver, an increase of about 250,000 tons during the year. The accounts show an income of £628,505 from the sale of lead and zinc concentrates, and a net profit of £187,684, out of which £49,138 has been paid as preferential dividend at the rate of 20%, and £134,824 distributed among the preference and ordinary shares, being at the rate of 30 per cent.

Bullfinch Proprietary.—This company belongs to the Doolette group, and was formed in 1910 to acquire a gold-mining property 23 miles to the northeast of Southern Cross, in the Yilgarn district of West Australia. It will be remembered that at the time of flotation the rich specimen ore caused a boom of short duration, after which the mine settled down to more ordinary routine. The report for the year 1913 shows that 52,679 tons of ore was raised and treated, yielding 33,760 oz. gold and 3975 oz. silver worth £143,809, being 54s. 7d. per ton. Milling started in February 1913 with stamps, tube-mills, and cyanide plant. The metallurgical treatment has improved, and the residue assayed 2s. 11d. per ton in December as compared with an average of 5s. 3d. over the 10 months. The bulk of the ore so far treated has come from the oxidized zone. Toward the end of the year some sulphide was mixed with the oxidized ore with no ill effects on the extraction. The net profit was £50,572, out of which £47,615 has been distributed as dividend, being at the rate of 10%. A. L. Hay, the manager, gives particulars of developments on the three orebodies. Nothing of importance has been found during the year on No. 1 orebody or Main Series; the deepest working is at 310 ft. In No. 2 or Southern Series, a large body of ore has been developed on the 100-ft. level, and the 210-ft. level appears to be equally promising. Fairly hopeful lenses of ore have been found on the 210 and 310-ft. levels in the No. 3 or Northern Series, but more work has to be done before any definite opinion can be given. The ore reserve is estimated at 145,582 tons averaging 36s. per ton in gold, and in addition 40,200 tons is returned as probable ore averaging 29s. per ton. It will be noted that the content of the reserve is much lower than that of the ore milled. Mr. Hay is against any deeper sinking for the present, and prefers that further lateral development should be done.

Great Fingall Consolidated.—This company was formed by Bewick, Moreing & Co. in 1899 to acquire a gold-mining property at Day Dawn, near Cue, West Australia. Milling started in 1900, and the plant was gradually increased until it contained 100 stamps. Excellent dividends were paid from 1901 to 1908, the total distribution being 1390% on a capital of £125,000. At the end of this period, the main orebody decreased in assay-value. By the advice of Malcolm MacLaren, development was undertaken below the 14th level at a point 1000 ft. north of the main shaft. As the results obtained were encouraging, an auxiliary shaft was sunk from the 13th level. The mine is now down below the 18th level, and the developments are all satisfactory. The orebody pitches still farther north. Owing to influx of water, further sinking has been suspended. The auxiliary shaft was completed toward the end of 1913. The report for the year 1913 shows that 64,255 tons of ore was raised, the largest quantities coming from the 7th, 11th, and 12th levels in the old

February 28 last shows that 96,468 tons of ore was raised from the Lake View and 119,575 tons from the Hannan's Star, making a total of 216,043 tons sent to the mill. Of the ore raised from the Lake View, about equal amounts came from the 300, 1200, 1400, 1600, and 1800-ft. levels, with smaller amounts from the 100, 400, 500, 1000, and 1900-ft. levels; at Hannan's Star, the 175, 300, and 500-ft. levels provided most of the ore. The total yield was 58,669 oz. gold worth £249,761, and the net profit was £33,090, out of which £32,000 was distributed as dividend, being at the rate of 16%, the same as the previous year. As regards development, the principal work during the year at the Lake View has been the cutting of two lodges on the 2100-ft. level. One of the lodges is not of great value as far as at present exposed, as the ore is bunched, but the other is more promising, as the part developed averages 51s. per ton over 5½ ft. At the Hannan's Star, no new orebody has been discovered, but the reserve has been substantially increased. The reserve



KALGOORLIE.

part of the mine. The yield of gold from this ore was 19,022 oz., or 25s. 3d. per ton, and from 108,547 tons of accumulated sand 6377 oz. was extracted; 303 oz. was extracted from accumulated slag. The mill also treated 3381 tons of custom ore. Forty out of 100 stamps ran for 64% of the time. The total income was £115,487 and the net profit was £2803. A dividend of £12,500 was paid out of the balance brought forward from 1912, being at the rate of 10%. As regards the ore reserves, 69,442 tons averaging 39s. 2d. is calculated as developed below the 14th level. All the ore above the 14th level has been extracted, with the exception of some broken ore left in the old stopes. Since the end of the year under review, the mill was closed, as, owing to the dangerous nature of the hanging wall, it was necessary to timber the drifts and fill the old stopes with sand. On the completion of this work, milling was resumed at the beginning of June.

Lake View & Star.—At the time of the reorganization of the Lake View Consols company in 1910, when the mining and promotion businesses were separated, the Lake View & Star company was formed to work the Lake View Consols and Hannan's Star mines, at Kalgoorlie, West Australia. James Brothers are the consulting engineers, and Bewick, Moreing & Co. are the general managers. The report for the year ended

at Lake View on February 28 was estimated at 79,434 tons averaging 27s. 11d. per ton, and at Hannan's Star 368,604 tons averaging 26s. 7d. per ton.

Oroya Links.—This company was formed in 1896 as the Golden Links to acquire property at Kalgoorlie. It was reconstructed in 1902 and in 1907, and in 1909 the 50-stamp mill of the Oroya-Brownhill and some of the exhausted mines of that company were acquired by the issue of shares. The capital is £312,500, and the only dividends have been 5% for 1910 and 10% for 1912. Bewick, Moreing & Co. are the general managers, P. Fitzgerald is superintendent, and T. J. Hoover, Edward Hooper, and J. H. Corder-James are on the board. The report for the year 1913 shows that 139,130 tons of ore was raised and sent to the mill. Of this, 68,757 tons came from the Eclipse, 48,076 tons from Oroya North, 16,077 tons from Brownhill, and 6036 tons from Block 45. The yield was 35,162 oz. gold worth £150,122, being an extraction of 21s. 6d. per ton. In addition, £1696 was received from tributaries, who have been working the Oroya South, True Blue, and several other of the leases. The accounts show a net profit of £15,462, which is carried forward. The ore reserve in the Eclipse is estimated at 146,775 tons averaging 24s. 3d. per ton, together with about 60,000 tons of probable

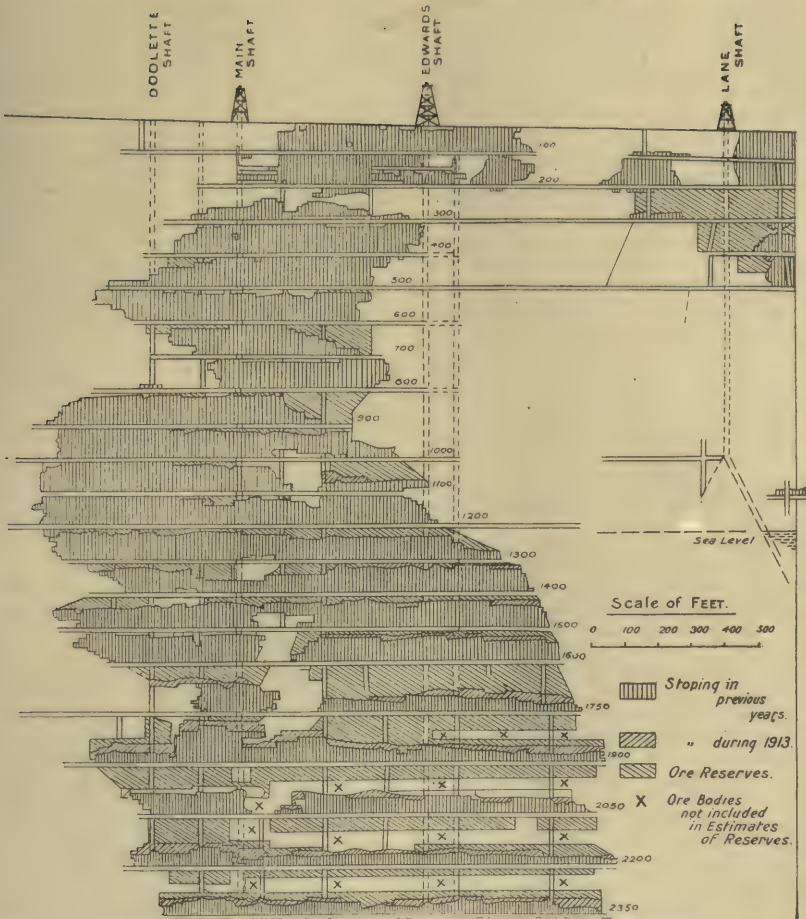
ore. Large amounts of ore are also workable in the Brownhill and Oroya North, but no estimate can be made of their content. Developments at the Eclipse have been fairly promising and the ore reserve has been increased. The shaft has been sunk to 945 ft., but the ore ceased to be profitable at 939 ft., so a level was opened at 900 ft. and development pushed at that point.

Great Boulder Proprietary.—This company was formed in 1894 to acquire property at Kalgoorlie, West Australia. Operations started in 1895 and dividends have been paid continuously since. The yield of gold was £107,023 in 1895, and it gradually increased until 1903 when the figure was £561,792. Since that time the yearly output has remained at practically the same level. Richard Hamilton has been manager since the beginning. Two years ago we recorded that the orebody showed signs of impoverishment, but nevertheless Mr. Hamilton has been able to maintain the reserve at about 3½ years supply. The report for the year 1913 shows that 189,469 long tons of ore was raised and treated, for a yield of gold worth £563,070, being an extraction of 59s. per ton. The net profit was £262,178, and the dividend absorbed £262,500. The ore reserve on December 31 was estimated at 615,114 long tons averaging 14.5 dwt. per ton, of which about 370,000 tons was between the 1500 and 2350-ft. levels in the Main Shaft section. The accompanying drawings show the workings. No shaft-sinking has been done during the year. Boring is to be done to a depth of 350 ft. below the 2800-ft. level. Connection has been made on the 2800-ft. level with the workings of the Golden Horse-Shoe, greatly to the benefit of both mines in the matter of ventilation.

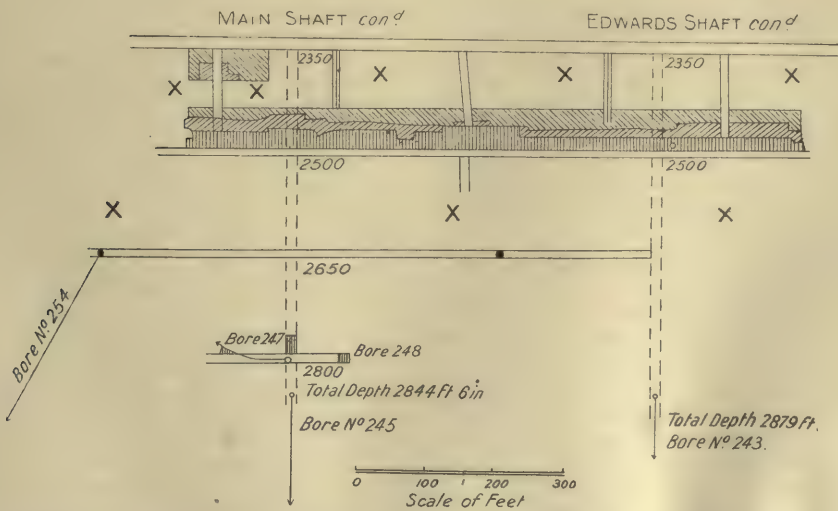
Golden Horse-Shoe Estates.—This company was formed in 1894 to acquire a prospect at Kalgoorlie, West Australia. Production commenced in 1899, and for eleven years the yield and dividends were well maintained, averaging 160,000 oz. and £250,000 per year respectively. In 1910 the yield fell suddenly and during 1911 and 1912 no dividends were paid. Conditions have slightly improved during 1913 and a dividend was earned. J. W. Sutherland has been manager from the start. The report for the year 1913 shows that 280,512 long tons was raised and treated for a yield of gold worth £414,351. The profit was £42,697, which, added to the balance brought forward from the previous year, made a disposable balance of £78,300. Out of this, £12,500 has been applied to the extinction of debentures, and £60,000 has been paid as dividend, being at the rate of 4%. The capital of the company is £1,500,000 and there are £81,300 debentures outstanding. Since the beginning of operations, 2,992,615 long tons of ore has yielded 2,128,210 oz. gold, and £3,135,000 has been distributed in dividends. Mr. Sutherland estimated the ore reserve on December 31 at 715,496 tons averaging 8½ dwt. per ton. Of this, 287,000 tons was in No. 2 lode and 408,610 tons in No. 3 lode. It is of interest to note that No. 4 lode, which passed into Great Boulder ground at the 900-ft. level, returned to the Horse-Shoe between the 2480-ft. and 2630-ft. levels. The lode has been cut during the year on the 2780-ft. level, where it was 16 ft. wide and assayed 14 dwt. per ton. On the same level a new lode has been cut, 4 ft. wide and assaying 10 dwt. per ton. It is interesting to note that at the commencement of milling in 1899, the ore reserve amounted to 226,900 tons averaging 2.64 oz. per ton. In 1903 the reserve was roundly three-quarters of a million tons averaging 1 oz. per ton. During the years 1907 to 1909 the reserve was maintained at 1 million tons averaging 12 dwt. per ton.

Seoul Mining.—This company was formed in 1908 under the laws of Connecticut, U.S.A., to acquire from the Collbran-Bostwick Syndicate the Suan gold-copper mine in Korea. This property had previously been worked unsuccessfully by an English company, the Korean Syndicate. H. Collbran is president of the company, A. H. Collbran is general manager, and A. R. Weigall is consulting engineer. The report for the year 1913 shows that 71,535 tons of ore was raised and milled, averaging 9.51 in gold and 1.02% copper. The recovery of gold was 86½%, but the concentration plant continues to be very imperfect, as only 20½% of the copper was extracted. The yield of gold in bullion was \$522,713 and in the concentrate \$66,323. The market value of the copper recovered was \$62,158, and bismuth selling for \$20,341 was also saved. The total yield was worth \$671,536. The operating cost was \$295,173, leaving a profit of \$376,363. After the payment of royalty to the former English owners, allowing for development of other properties, and writing-off depreciation, a net profit of \$251,595 was left, out of which \$200,000 has been distributed as dividend, being at the rate of 50%. Previous dividends for 1910 to 1912 have been 25, 50, and 50% respectively. The development done at the Suan during the year totalled 5505 ft. and the ore reserve on December 31 was estimated at 315,538 tons averaging 9.08 gold, 1.04% copper, and 1.7 lb. bismuth per ton. By the introduction of slime tables, a great improvement is contemplated in the extraction of copper, as much as 75% being figured as the recovery. During the past year, the adjoining Tul Mi Chung mine has been actively developed, and on December 31 the reserve was estimated at 276,880 tons averaging 6.08 gold, 1.37% copper, and 0.8 oz. silver. It is stated that the stopping width at the mine will in places be as much as 80 ft. and that the cost of mining will accordingly be low. As the content of copper appears to be increasing with depth, it was decided to ask the advice of a copper metallurgist with regard to the treatment. The services of W. G. Perkins were obtained. His report will be delivered shortly. The company also owns a large mineral belt known as the Collbran contact. D. F. Higgins, late of the United States Geological Survey, has made a geological examination of this belt. During the year, the denomination of the shares of the company has been altered from \$100 to \$25 by splitting each share into four. The reserve 4000 \$25 shares have been issued at \$125 each, and the funds, \$500,000, thus raised will be devoted to the erection of a treatment plant at Tul Mi Chung and an electrical power-plant for this mine and the Suan.

St. John Del Rey.—The eighty-third annual report of this company, operating the Morro Velho gold mine in the state of Minas Geraes, Brazil, covering the year ended February 28, shows that 175,823 tons of ore was raised, and after the rejection of 0.8% waste, 174,000 tons was sent to the mill. The yield of gold was 97,208 oz., worth £414,410, besides which gold worth £4000 was recovered from rusted sand, etc. The yield per ton was worth 47s. 7d. The working cost, including development and London expenses, was £283,166, royalty, etc., £19,895, debenture interest £1958, directors' percentage £2731, and income tax £3837. Out of the balance, £35,000 was allocated to capital expenditure, £10,000 was paid as dividend on the 10% preference shares, and £54,627 was paid on the ordinary shares, being at the rate of 10%. The tonnage milled was slightly in excess of that for the previous year, but was considerably less than that for the year ended February 1912. The cause of the lower figure was the shortage of labour during the



THE MAIN WORKINGS AT GREAT BOULDER PROPRIETARY.



DEVELOPMENT WORK IN LOWEST LEVELS AT GREAT BOULDER PROPRIETARY.

first half of the financial year. The yield of gold was £22,301 higher than during the preceding year, the extraction per ton being 47s. 7d. as compared with 46s. The yield per ton has of late years shown a steady increase, and compares with 43s. 7d. when the mine was re-opened 30 years ago. On the other hand, the working cost at the mine is higher this year, owing to increases in wages and expenses in connection with certain alterations in methods inaugurated for the ultimate reduction of costs. The labour situation has greatly improved of late and the full complement of men is now in employ; this is due to several railways and public works having been suspended. The scheme for importing Japanese labour has proved a failure, as the men did not appear to relish deep mining and gradually deserted. As regards developments at the mine, the 'G' shaft has been sunk 223 ft. below the 18th or 5226-ft. level. It is to be continued to 5526 ft., and then a drift will be started to intersect the lode. The 18th level has not been fully developed, but the ore is reported to compare satisfactorily with that in the 17th level. The output of ore during the year was taken in nearly equal proportions from the 13th to 17th levels, with smaller amounts from one of the old upper levels and from the 18th level. Filling to the extent of 135,573 tons was put in place during the year. The reserve of developed ore at February 28 was estimated at 887,400 tons, a gain of 74,000 tons during the year. George Chalmers, who re-opened the mine in 1884, continues to direct the fortunes of this remarkable mine.

Ouro Preto Gold Mines of Brazil.—This company was formed by John Taylor and Sons in 1884 to acquire the Passagem gold mine in the state of Minas Geraes, Brazil. Reconstruction was necessary in 1893, and a further reorganization for the purpose of introducing additional capital is now being proposed. Small dividends on the ordinary shares were paid in 1895, 1896, 1902, 1908, 1910, and 1911. The mine is in the same geological district as the St. John del Rey, but the deposit is of lower grade. A. J. Bensusan is manager. The report for the year 1913 shows that 66,139 tons of ore was raised and sent to the mill, where gold worth £90,433 was extracted, being 27s. 4d. per ton. The year before, 68,486 tons was raised, and the yield per ton was 31s. 2d. The working cost was £90,452, and £3584 was allowed for depreciation, so that the year ended with a small deficit. The fall in the yield was due to the stopes on the 770-metre level proving to be poor. On the lowest level now being opened at 920 metres, the ore shows a substantial improvement, so that the outlook is brighter. The Paredao shoot on the 215-metre level has also given cause for expecting an improved ore supply. The labour question has continued to cause anxiety, for railway and other surface works provide rival attractions. The Passagem lode is flat and the men descend and ascend the shafts on foot. In order to avoid this unnecessary exertion, cars are now being provided. The feeding arrangements have also been improved. It is hoped by studying the men's comfort in these and other ways that labour-shortage will no longer be felt. The directors during the year commissioned Thomas Richards to examine the mine with a view to determining, in conjunction with Mr. Bensusan, the best way of conducting operations in the future, in the hope that the mine may be restored to financial prosperity. He recommends that the scale of mining should be extended, and the monthly output raised to at least 7000 tons, and if possible to 10,000 tons. To effect this it would be necessary to sink a new incline shaft in the neighbourhood of the Paredao shoot, and

to provide additional hoisting and metallurgical plant. The capital expenditure required for this purpose is estimated at £30,000. This money is to be raised by the issue of new preference shares, and at the same time the present capital is to be drastically reduced. The £100,000 ordinary shares are to be written down to £15,000, and the £36,634 preference shares are to be exchanged for £12,212 in new preference shares and £24,424 in new ordinary shares. With the expanded system of working it is hoped to reduce the cost to 21s. per ton and to extract gold worth 26s. per ton. On December 31 the ore reserve was estimated at 114,528 tons, as compared with 125,193 tons a year previously.

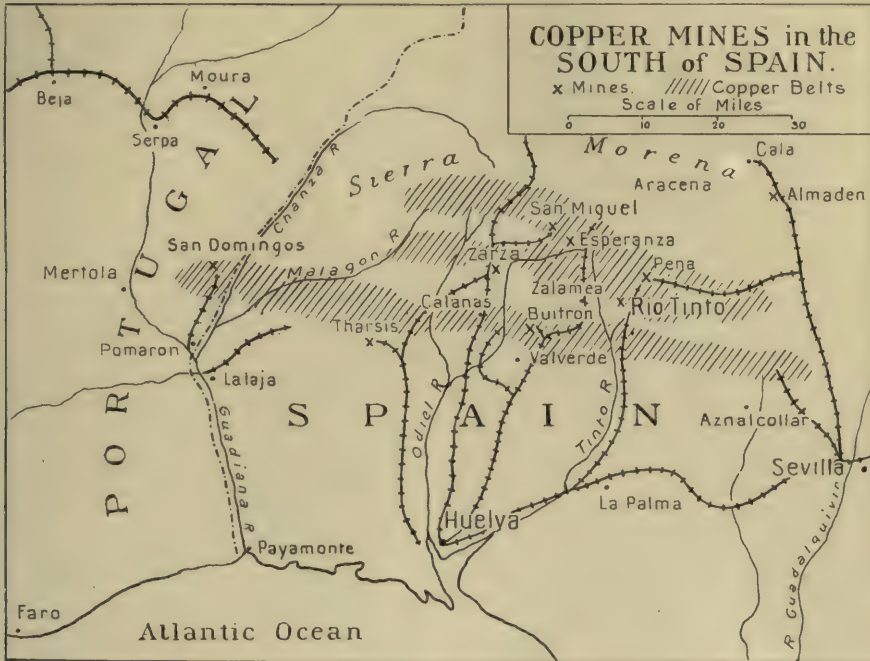
Poderosa.—This company continues on its chequered career, but is apparently nearing its end. Formed in 1908 to acquire a group of copper mines from local owners at Collahuasi, Chile, it gave promise of the profitable mining of high-grade ore. But the early directors failed to give financial support for adequate development and began distributing dividends. The mine has never recovered, and the ore has been stoped immediately on its discovery so as to maintain an output. There are therefore no reserves, and the maintenance of the workings in good order has been neglected. A succession of managers, Robert Hawxburst, C. H. Macnutt and William Watson have been able to do little to improve matters. J. H. Ivey, the present manager, is engaged in sinking deeper. The great elevation above the sea and the harsh climate are against good work being done under disadvantageous circumstances and financial worries. The report for the year 1913 shows that 7743 long tons of ore was mined, and 7793 tons was shipped averaging 18·9% copper and 4·6 oz. silver. During the previous year, 11,318 tons was shipped, averaging 22% copper and 8·8 oz. silver. The dumps contain 142,400 tons of ore averaging 3·6% copper. A small concentrator has been ordered for the treatment of this dump material, and it should be at work by September. The accounts show an income of £67,487 from the sale of ore, expenses £55,903, allowance for depreciation £4919, and amount written off development account £8853. A description of this group of mines was given in our issue of October 1910.

Esperanza Sulphur and Copper.—This company was formed in 1906 to acquire the Esperanza group of pyrite mines in the province of Huelva, Southern Spain. Robert Addie reported on the properties, and T. D. Lawther is now the general manager. Sir Robert Price is chairman of the company. The capital is £350,000, and £100,000 debentures were issued to the vendors. Of the debentures £45,990 have been redeemed out of profits, and the shareholders received small dividends from 1908 to 1912. The report for the year 1913 shows that 40,746 tons of ore was raised from the Angostura mine, and 55,044 tons from the Esperanza-Forzosa group. In both cases the Spanish labour troubles reduced the output. Also, at the Angostura a flood suspended mining for a month; at the Forzosa the lining of the shaft with reinforced concrete and at the Esperanza the re-timbering of the shaft interrupted hoisting for a month or two. The amount of ore shipped from Huelva was 118,858 tons, and the production of copper precipitate was 98 tons. The amount of copper in the ore is lower than formerly, a fact reflected in the smaller amount of precipitate produced and the decreased shipments of ore on copper content. This causes a decrease in the income, as sulphur ore is much less profitable than copper ore. The smaller shipments and the lower price of copper have also been against the company. The profit for the year was

£17,441, out of which £2794 was paid as debenture interest and £7323 allocated to the redemption of debentures. The shareholders received no dividend, as it was deemed advisable to carry funds for further debenture-redemption requirements. The developments at Angostura have increased the reserve from 230,000 tons to 361,000 tons, but the extent of the north orebody on the 4th level has been proved smaller than on the levels above. At the Esperanza the developments at depth have been satisfactory. On the other hand, the Forzosa orebody has practically vanished below the 5th level. The ore reserve at the Esperanza-Forzosa group is estimated at 560,000 tons.

San Miguel Copper Mines.—This company was formed in 1904 to acquire a pyrite property in the Huelva district of Spain from a company registered

Matabele Queen's.—This company was formed in 1910 as a subsidiary of Willoughby's Consolidated, to work the Queen's gold mine in the Bembezi district of Rhodesia, 28 miles northeast of Bulawayo. The report for the year 1913 shows that the 10 stamps and 2 Wheeler pans treated 19,915 tons of ore for a yield of gold worth £20,299, and the cyanide plant extracted gold worth £27,087, the total yield being £47,386. The net profit was £1094. The sum of £10,000 out of the balance brought forward from the previous year has been devoted to reducing the development account. During the year £5947 has been spent on capital account. The reserve on December 31 was estimated at 44,489 tons averaging 43s. 5d. per ton. Disappointing results attended the development on the 7th level, and on the advice of A. H. Ackermann, the consulting



locally. The directorate was reorganized in 1907. The bulk of the shareholders are on the Continent. Nicol Brown is one of the directors, Dr. N. Bruckner is managing director, and the control is the same as that of the Pena company. The issued nominal capital was increased from £163,023 to £200,000 in March 1913. At first, quarterly dividends were distributed, but it was soon found that they were not justified, and those responsible had to resign. Then followed some years of financial recuperation under the direction of the present board, and another dividend was not paid until 1912. The report for the year 1913 shows that 75,265 tons of ore was raised, of which 50,667 tons was sent to the leaching floors and 24,598 tons delivered for export. The precipitate recovered contained 616 tons of fine copper. The deliveries of washed ore sold for sulphur content were 69,524 tons. The accounts show a trading profit of £21,210, out of which £5267 was allowed for depreciation, £4186 spent on administration, and £5483 written off to extinguish the mine-development account. The shareholders received £9538, being at the rate of 5%, partly provided from the balance brought forward from the previous year.

engineer, a winze has been sunk to the 8th level and is being continued to the 9th. The results are stated to be encouraging. The balance sheet indicates that the finances of the company are not satisfactory, as there is an item of creditors £11,351, of which £6805 is owing to the bank. The capital of the company is £180,000.

Thistle - Etna Gold Mines.—This company was formed in 1908 to acquire the Etna gold mine in the Hartley district of Rhodesia, from the Exploring Land & Minerals Company, together with the Thistle, Thunderbolt, Faith, and other adjoining claims. A metallurgical plant, consisting of a Chilean mill and cyanide plant was erected at the Etna mine, having a monthly capacity of 3000 tons. Milling was suspended during most of 1912 owing to scarcity of labour and depletion of reserves, and was recommenced at the end of September of that year. The report for the year 1913 shows that 24,366 tons of ore was raised from the Etna, 6000 tons from the Thistle, and 2254 tons from the Faith. The mill treated 37,041 tons, some of it being accumulated ore. The yield of gold was 13,847 oz. worth £58,457, and the mining profit

was £17,498. Out of this, however, £5965 had to be written off for depreciation, and £1087 was paid as London expenses. No dividend has yet been paid. As regards the future, the ore reserve in the mines amounts to 10,434 tons averaging 8.1 dwt., and on the dump to 7000 tons averaging 5 dwt. Most of this ore is in the Etna, as the Thistle, which only started production in March 1913, is practically exhausted, and at the Faith the lode has disappeared. The control of the company is with the Consolidated Gold Fields, and A. J. Fraser is consulting engineer.

Village Main Reef.—This company was formed in 1888 to acquire claims on the dip of the City & Suburban and Jubilee mines in the central Rand. Additional property was subsequently purchased at various times, and in 1906 the Wemmer mine was absorbed. Milling commenced in 1892. A new mill was built in 1898, and further stamps were added in 1899. The 60 stamps acquired with the Wemmer brought the total number to 220. The office of the company is with the Consolidated Gold Fields, but the technical control is in the hands of the Central Mining. Robert Raine is manager. The end of the mine is approaching, and the life cannot be much more than three years. The reserve is estimated at 1,166,000 tons, averaging 32s. 9d. per ton, and the amount of ore contained in two small areas not yet developed is calculated at 350,000 tons. The report for the year 1913 shows that 524,431 tons was raised, and after the rejection of 17% waste, 435,615 tons averaging 37s. 9d. per ton was sent to the mill. The yield of gold was 187,051 oz., worth £786,343, or 36s. 1d. per ton milled. The working cost was £405,795, or 18s. 7d. per ton, leaving a profit of £380,547, or 17s. 5d. per ton. The shareholders received £330,400, being at the rate of 70%. Since dividends were first paid in 1898, the total distribution has been £3,242,343. The company has £378,430 cash in hand, and £203,422 has been invested in 115,000 shares in the Village Deep.

Durban Roodepoort Deep.—This company belongs to the Central Mining group, and was formed in 1895 to acquire claims on the dip of the Durban Roodepoort mine in the west Rand. Milling commenced in 1898, and the first dividend was paid in 1908. Profits have been on a restricted scale, as the total distribution to date has only been 47½% on a capital of £440,000. This result has not justified expectations or the issue of many £1 shares at prices ranging from £2 to £4. The report for the year 1913 shows that 335,009 tons was raised, and after the rejection of 13% waste, 291,660 tons averaging 30s. 2d. per ton was sent to the 100-stamp mill. The yield was 70,799 oz. by amalgamation and 29,319 oz. by cyanide, a total of 100,118 oz., worth £420,412 or 28s. 10d. per ton milled. The working cost was £356,176 or 24s. 5d. per ton, leaving a working profit of £64,235 or 4s. 5d. per ton. Out of this £6323 was paid to the Phthisis fund, and £4027 as profits tax, while £9192 was allocated to capital expenditure. The shareholders received £22,000, being at the rate of 5%. Owing to the scarcity of native labour, it was impossible to maintain a full force for working the more profitable South Reef and it became necessary to mine a larger proportion of the Main Reef, using machine-drills. Consequently, though the tonnage was maintained, the yield per ton was 1s. 1d. less than during 1912, and the working profit was £18,000 less. The ore developed during the year was 268,200 tons averaging 6.8 dwt. per ton. The reserve on December 31 was 569,800 tons averaging 6 dwt. in the Main Reef and 742,900 tons averaging 7.2 dwt. in the South Reef. The mine is still suffering from shortage of labour.

Worcester Exploration & Gold.—This company was formed in 1887, under Cape laws and with offices at Worcester in that province, to acquire claims on the outcrop in the central Rand, between the Robinson and Ferreira. Operations were profitable, dividends from the start until the war totalling 422½%; after the war the property was sold to the Ferreira company for £90,000, a good return for a company having a nominal issued capital of £95,722. In 1898 the company acquired the Kentish property, 15 miles northeast of Barberton, in the De Kaap goldfield, and in the following year purchased the adjoining Bonnie Dundee. Since 1909, dividends have been paid, but on a smaller scale. The report for the year 1913 shows that the 40 stamps and 2 tube-mills treated 68,540 tons of ore averaging 4.86 dwt. per ton, an increase in tonnage of 9000 tons but a decrease in assay-value of 0.86 dwt. as compared with 1912. The yield of gold by amalgamation was 9452 oz. and by cyanide 4827 oz., a total, with by-products, of 14,280 oz. worth £60,554. The yield per ton was 17s. 8d., as compared with 21s. 2d. the year before. The working profit was £15,305, out of which £1016 was paid as profits tax, £350 paid as directors' fees, £8516 written off for depreciation, and £7179 paid as dividend, being at the rate of 7½%. R. Wormald, the manager, reports that the recent developments do not point to any improvement in the yield during 1914. Owing to scarcity of labour, the reserve has not been maintained, standing at 90,000 tons, a decrease of 20,000 tons. The shaft below the 6th level has been sunk as an incline, dipping at 55°. This incline has been sunk 200 ft., and a 7th level opened; it is to be continued 40 ft. more, and an 8th level started.

West Rand Consolidated.—This company belongs to the Albu group, and was formed in 1903 to acquire property in the far west Rand, between the Randfontein and Lancaster mines. In 1907 the property of the Violet Consolidated was absorbed, 60 stamps being acquired as well as the mine. Milling commenced in 1908, and the equipment now consists of 100 stamps and 4 tube-mills. Work is being done on both the Main Reef Series and Battery Reef Series. Much shaft-sinking and development has been recently done with the object of expanding operations, and eventually doubling the output, but the shortage of labour has been acute since the strike last July, and the scheme is checked for the present. The capital of the company is £1,979,424 in ordinary shares and £25,000 in deferred shares. Of the shares, 1,175,964 ordinary and all the deferred represented purchase price, and 500,000 were issued at £2. 2s. 6d. each in 1905. There are also £500,000 debentures, issued in 1909. The only dividend was one of 3½% paid in 1909. The report for the year 1913 shows that 401,235 tons of ore was raised, chiefly from the Main Reef Series, and after the rejection of 20% waste, 321,050 tons was sent to the mill. The yield by amalgamation was 63,153 oz. and by cyanide 44,663 oz., being a total of 107,816 oz., worth £456,271 or 28s. 5d. per ton milled. The working cost was £365,052, or 22s. 9d. per ton, leaving a working profit of £91,218, or 5s. 8d. per ton. Out of the profit, £29,320 was paid as interest on debentures, £5544 as profits tax, and £6997 as contribution to the Phthisis fund, the balance being carried forward. Development during the year consisted of 760 ft. of shaft-sinking on the Main Reef Series and 1305 ft. on the Battery Reef Series, and 5573 ft. of driving, sinking, and rising on the Main Reef Series and 11,905 ft. on the Battery Reef Series. The reserve on December 31 was returned at 1,364,956 tons averaging 6.16 dwt. per ton.

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Scientia non habet inimicum nisi ignorantem.

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❖ REVIEW OF MINING ❖

INTRODUCTORY.—“Tis a mad world, my masters.” Only a month ago we expressed the expectation that conditions were becoming more favourable for business, that “a glimpse of blue sky” was visible overhead. Not many days thereafter a black cloud darkened the heavens in the east, with a mighty rushing wind, and the thunder of a storm the like of which no man living has ever heard. The full fury of destruction fell on European civilization, intelligent men lapsed instantly into ensanguined barbarism, and the culture of the modern world took the aspect of a grinning devil. It is futile now to discuss the causes of the great catastrophe. This is not a political journal; we can but await the event with quiet fortitude, with the hope that this fit of bestial madness may not last too long, and that those responsible for it, on which ever side they are ranged, may be blighted to all eternity.

TRANSVAAL.—The exigencies of the time render it necessary for us to go to press a few days earlier than usual, so we are not able to quote the usual statistics. It is likely that the gold output of the Rand will be stored in South Africa until transport is safe.

Supplies of drill-steel are a bit scanty on the Rand; otherwise the mines are well stocked with the requisite material. We refer elsewhere to the sources from which supplies of cyanide and mercury are derived. The explosives used in South African mines are manufactured near Cape Town and at Modderfontein, on the Rand itself; but the raw material from which the ingredients are

made, namely, glycerine, nitrate, and sulphur, are imported, so that the supply depends upon our keeping the trade-routes open.

Postal difficulties have been given as a reason for the postponement of dividend disbursements. This is misleading; the real reason is the moratorium, whereby the payment of debts is suspended. The companies are unable to recall the money out at interest with the banks at the present time.

It is pleasing to note the increase of production by the East Rand Proprietary, which, with a yield of £241,100, in July did better than it has for a twelve-month. Moreover, the cost has dropped 11d. per ton, giving a nominal profit of £82,231 for the month.

The Modderfontein Deep has been deservedly prominent by reason of favourable developments and the near prospect of production. At the end of this year the reduction plant, of 60 stamps and 6 tube-mills, will be ready for work. Meanwhile, a reserve of ore equivalent to four years' supply has been opened up. This reserve is estimated to consist of 2,180,000 tons averaging 35s. 3d. per ton, as against a 'working cost' of 18s. per ton. Allowing 15% difference between 'working cost' and actual total cost, and deducting 10% for loss in treatment, the ultimate yield to shareholders may be taken as 11s. per ton, or about £1,200,000 from the tonnage already proved. This is good enough, although considerably less than the one-eyed calculation of a 'Holder of Shares,' and other optimistic commentators.

RHODESIA.—In June the output of gold

exceeded £300,000 for the first time. The exact figures are £306,421, which compare with £241,303 in the corresponding month of last year. The Cam & Motor contributed £15,204, the Shamva £28,561, and the Eileen Alannah £4171. Among the older producers, the Giant decreased from £7048 to £4414, while the Antelope increased from £7722 to £9796, and the Globe & Phoenix from £31,685 to £41,832. The number of producers was only 209, as against 220 in May.

The Shamva meeting passed pleasantly. We note that a shareholder asked the chairman, Mr. E. Birkenruth, when the absorption of gold by the plates would cease. Of course, the chairman could not tell. We can state that the amount of gold retained by a well set plate is normally one ounce per square foot of plate. As regards the probable life of the mine, the chairman asked to be excused from making an estimate. Naturally, for he could not know, being untechnical; but surely the consulting engineer has been asked the same question by Mr. Birkenruth, and it is the engineer's reply to this vital query that the shareholders are entitled to have. The general character of the orebody has been ascertained and the information available should be enough to warrant an estimate, if for no other laudable purpose than to check optimistic expectations of unlimited persistence.

The report of the Eldorado Banket company is a pathetic evasion of realities. A "satisfactory increase" in the ore reserve "since January" is stated, as against the brutal fact that there has been a decline in resources during the year from 74,300 tons of 16'4 dwt. ore to 47,950 tons of 13'7 dwt. ore. The "gradual lengthening out and widening of the main reef pay chute" as phrased by the consulting engineer, Mr. H. A. Piper, compares with the fact that the ore-shoot is 130 feet long on the 12th level, in comparison with 105 feet on the 10th—an increase of 25 feet accompanied, it is true, by a widening of

4 feet, but associated with a decrease of 5 dwt. per ton in the gold contents. Later work has proved the orebody to be only 65 feet long on the 13th level. Speaking of this development as a "satisfactory increase" is, let us say, unscientific. The so-called parallel reef has 'petered out.' In order to keep step with the extraction of ore and to prevent the rapid exhaustion of the reserve, it will be necessary to sink the main shaft four levels, each 125 feet apart, per annum. An increment of 500 feet in depth annually will test even the most robust faith in the persistence of ore in Rhodesia. It remains to compliment the management, not on its conveyance of salient information, but on a reduction of 1s. 8d. per ton in the cost of operations.

WEST AFRICA.—The output of gold in June, £147,249, was the best for any month this year. No noteworthy individual changes are recorded, all the principal mines contributing their usual quota.

The Prestea continues to disappoint its shareholders. In 1913, the recovery declined from 85 to 81%, which means 1s. 8d. per ton, as against the decrease of 3s. 4d. in the working cost. The reserve has fallen from 835,000 tons averaging 44s. per ton to 691,670 tons averaging 41s. per ton, mainly owing to a recasting of the estimate and the exclusion of doubtful blocks. The margin of actual profit is small and contrasts sadly with the optimistic estimates of 1909. An improvement in the metallurgy of the ore is being developed; while details are not available, we understand that the chief point is the addition of a chemical with the power to re-dissolve the prematurely precipitated gold.

From an engineer recently returned from Nigeria, we gather the impression that the country below the plateau in the southern part of the Nassarawa province is not likely to afford scope for successful mining. In this region are the Abu, Ninkada, Karama, and Keffi operations. No real alluvial deposits have

been found, only patches of debris derived from the degradation of pegmatite dikes. For such tin-bearing ground the native system of calabashing suffices; systematic sluicing is hindered by the lack of water, the smallness of the deposits, and their separateness.

The intimation made in our last issue regarding the assumption of technical control by the Niger Company over the operations of sundry Nigerian tin mines is confirmed. The announcement was made at the Forum River meeting by the chairman, Mr. Harry Cotterell. The Niger Company's engineers, the firm of Laws, Rumbold & Johnson, will act as supervising engineers to the Forum River, Bisichi, Lafon River, Ninghi, Zuma, and Northern Nigeria Trust, the last mentioned having been the incubator of most of the other companies mentioned.

AUSTRALASIA.—The Broken Hill Proprietary company has made an issue of £600,000 debentures, carrying interest at the rate of 6%, for the purpose of obtaining the remainder of the capital required in connection with the establishment of the iron and steel works at Newcastle, New South Wales. In September 1912, when the iron project was first broached, the intention was to provide the capital by the issue of 540,000 new shares, but when 240,000 of these shares, the nominal value of which was 8 shillings, were offered at 40 shillings, the response was not as great as expected, and only 210,000 were placed. Hence the change in the method of raising the remainder of the capital. The debentures proved attractive, and the issue was most successful.

Mr. J. W. Sutherland, the manager of the Golden Horseshoe, at Kalgoorlie, is able to announce that he has cut the No. 4 lode on the 2900-ft. level, where it is found to be 15 feet wide, of 12 dwt. ore.

We note that the widow of Walter Hall, of Mount Morgan, has subscribed £10,000 to the war-distress fund at Sydney.

RUSSIA.—Fortunately the metal-mining

operations in which Anglo-American capital is involved are in Siberia, at a long distance from the scene of war. Delays to the delivery of machinery and supplies may be expected, but no necessary interruption to operations.

By inadvertence the data in our last issue concerning the Atbasar mine referred to the Spassky. Those informed concerning either of them will have detected the error. The completion of the deal between the Spassky and Atbasar companies transferred 146,876 Spassky shares to the Atbasar shareholders in exchange for 293,752 Atbasar shares. The Spassky Copper Mine, Ltd., has now issued 979,070 shares. The main shaft is to be sunk to the 700-ft. level. Developments on the 630-ft. level are satisfactory, as detailed in our last issue. At the Atbasar mines the ore reserve is estimated to be 543,900 tons averaging 10·7% copper. The concentrator and smelter are in course of erection at Karsak Pai, 30 miles from the mine, and are expected to be ready at the end of next year. A good supply of coking coal is being opened up at the Baikour colliery, which is about 30 miles from the smelter, the latter being roughly equidistant from the copper and coal mines.

The Chairman of the Kyshtim Corporation, Mr. C. F. H. Leslie, was able to make a clear and cheerful statement at the recent meeting. It is estimated, by Mr. R. Gilman Brown, that the output of copper during the current year will be 9000 tons, as against 7832 tons last year. The plant, with its new reverberatory furnaces and refinery, is capable of an output of 10,000 tons of pure metal. Owing to the gold and silver extracted as by-products, an ore yielding only 1% copper is now within the economic limit of operations. This result reflects the excellence of the equipment and technical management. The reserve of ore is less than a year's output, but this is due to the fact that exploratory work, by boring, does not prove blocks of ore, although it indicates the probabilities of expansion.

Last year we made reference to the official statements of the Orsk Goldfields and the Troitzk Goldfields companies as illustrating the misleading use of the term 'working profit.' Now, twelve months later, we have the annual reports of these two companies, and again they illustrate the pitiful absurdities arising from an inexcusable misuse of terms. The Orsk report shows "a gross working profit" of £36,563; after sundry deductions for expenses essential to dredging in Siberia have been made, a "net profit" of £18,373 remains; finally, after allowing for further inevitable expenses, a final "net profit for the year" of £680 is recorded. The Troitzk goes through the same performance; a 'working profit' of £11,627 becoming an actual loss of £5524. The use of the word 'profit' in these cases is a *reductio ad absurdum*.

CANADA.—The Nipissing Mining Co. is reported to have bought a block of shares in the Teck-Hughes, in which the Union & Rhodesian Trust owns 200,000 shares. A new company called the North-East Kirkland Mining and Development Co. has been registered at Toronto. The name of Mr. Frank C. Loring appears on the prospectus as consulting engineer. Messrs. Fielding, Son, and Macleod were reported to have guaranteed the working capital, but this was denied later. The property involved consists of a block of 37 claims, including the Wright-Hargraves group.

The Associated Gold Mines of Western Australia has exercised its option on the North Thompson property at Porcupine, both Mr. E. T. McCarthy and Mr. Edward Hooper reporting favourably upon it. These engineers report that the prospects of the neighbouring Keeley mine, in which the Associated is interested jointly with Huronian Belt Co. (controlled by L. Ehrlich & Co.), are excellent.

UNITED STATES.—A curtailment of copper production, on account of the state of Europe, is foreshadowed. The Anaconda Copper Company has suspended work at its Great

Falls smelter, and at seven of its mines, usually responsible for an output of about 3000 tons of copper per month. It is likely that this move was hastened by the recent enlargement of capacity at the Washoe plant (at Anaconda itself) by reason of improved reverberatory practice, involving the use of coal-dust fuel.

The monetary conditions that made the 1907 panic so severe are not being repeated at this time owing to the remedial currency legislation. Clearing-house certificates are being issued to cover obligations between banks. The completion of the Federal Reserve Board and the publication of the Interstate Commission's railway decision are favourable factors. Pig tin has advanced 26 c. per pound at New York during the week ending August 6, thus bringing the price to 57 c. per pound. This is equivalent to about £250 per ton. An advance of \$1 per ton in steel billets is reported from Pittsburg. All metal prices are in a chaotic condition.

We are glad to see that an effort to entice London capital into the Bishop Creek mine, in California, has failed. The evidence regarding the value of the mine is of the old-fashioned variety: the vendor's statement. The connection of sundry American officials with the property has a sentimental interest only; it does not indicate the tonnage of ore available for dividends. For that, only one kind of witness is of any consequence, namely, an experienced engineer known in London.

Oroville Dredging pays a 6d. dividend in August, and expects to pay another in October. This is rendered possible by the improved returns from the Pato dredge, in Colombia. Recent yields have averaged about 70 cents per cubic yard, from ground adjacent to that which was dug last year. In default of fuller information, it may be assumed that the highly productive area is extremely restricted.

MEXICO.—Amid the turmoil nearer home the disorders of Mexico are almost forgotten.

The peaceful elimination of General Huerta has been followed by the provisional presidency of Señor Francisco Carbajal, a prominent lawyer, and a real effort to make peace between the Federalists and the Constitutionals under General Carranza. It appears probable that ere now the armistice has been followed by a peaceful entry of Carranza's troops into Mexico City. Pachuca was captured by them, without fighting, and without looting, on August 4. Villa, the master brigand, has broken with Carranza and mobilized his adherents at Torreón.

Orosco started a counter revolution in the North as soon as Carranza's revolution seemed about to come to a successful ending, by Huerta's resignation and departure, but later he seems to have thought better of it, for on July 27 it was announced that he intended to retire to Canada.

The purchase of the Nolan ground by the Mexico Mines of El Oro was ratified at Paris on July 25. At the same time the capital was increased to £210,000 by the creation of 30,000 new shares, which constituted the price paid for this adjoining property. The deal has been impending ever since the Exploration Company lost control of the management.

INDIA.—In our editorial columns we refer to the fall in the market quotations of the Mysore shares. We there show that the orebodies in the lode that is worked by the Mysore, Champion Reef, Nundydroog, and Ooregum companies pitch at a low angle to the north and that as the Mysore is the southernmost of these there is no immediate prospect of a richer zone being found in depth, seeing that no orebody outcrops to the south of the boundary. Prospecting has, however, been done during the past year from the 2100-ft. and 2300-ft. levels of the Mysore into this ground, in the hope of finding an orebody in depth. Encouragement for this policy is to be found in the fact that in other mines on the lode, orebodies have been discovered at

depth that did not persist upward. So far the work has not met with success.

VARIOUS.—The Aporoma Goldfields is the subject of widely discrepant estimates, Merriks, Crane & Co., the engineers to this company, having stated that 51,000,000 cubic yards of gold-bearing gravel was available for hydraulicking, while Mr. W. H. Brethour, an engineer recently in British Columbia and representing French interest in the enterprise, asserts that only 3,970,000 square feet of bed-rock is covered by gravel. He does not give the thickness, but Mr. Crane estimated it to average 48 feet. We understand, moreover, that the larger estimate is based on actual survey, contour maps, and sectional exposures of the deposit, while that of Mr. Brethour is a rough guess from a brief investigation. Lack of water has impeded progress, the total yardage treated so far being 139,800, yielding 7'4d. per yard. This result is encouraging. However, successful placer mining depends as much on the water available as on the gold in the gravel. A modified plan, involving an outlay of £11,000, has been authorized to increase the water storage and to enlarge the pipe-line. Mr. Wallace Fraser is the resident manager.

The daily Press has duly announced that a director of the Indimba Tin Alluvials, in Swaziland, has cabled the fact that he made a test, a sample of the concentrated pannings of the tin gravel being assayed for a yield of 13'8 dwt. gold per ton. As the ratio of concentrate to gravel is not considered, the statement has as much bearing on the probable production of the property as the colour of the flowers that bloom in the spring.

It is reported that a winze connecting the 5th to the 6th level in the Bushtick mine in Rhodesia has cut through ore assaying 32s. per ton. This mine is largely the individual venture of an enterprising operator, Mr. R. R. Hollins; we hope, therefore, that the news presages an important development.



EDITORIAL



“ENGLAND expects that every man this day will do his duty.”

TODAY, August 15, the Panama Canal will be opened to the world's commerce for vessels not requiring over 30 feet of water. The formal opening takes place in March next year. “Peace hath her victories no less renowned than war.”

THE contents of this issue are not uniform in tone. Some portions of it were written before the war began, others after. During two weeks we have gone through an interval that measured in terms of sentiment is equal to a geological period.

AT the time of writing all the metal and stock exchanges of Europe and America are closed. The American Copper Producers' Association has ceased the issuance of its monthly statistical statements.

ON BEHALF of the committee of the Mining and Metallurgical Club, the president, Mr. Edgar Rickard, has offered the premises to the Red Cross Society for use as a temporary hospital.

CABLEGRAMS from the mines are brief owing to the military regulations now in force, whereby the use of code language is forbidden.

LIEGE, famous now for its heroic defence by the Belgians, is the seat of an important zinc smelting industry, receiving ores

from all over the world. This ancient city is also notable as the place where an Englishman, John Cockerill, founded one of the great steel industries of Europe.

PAYMENT of dividends by the South African companies has been deferred, as the money is out at loan and cannot be immediately released, owing to the financial stringency.

IT is reported from Kimberley that the De Beers diamond mines are being closed down, but sufficient men are retained to keep the workings dry. The natives in the employ of the company are being repatriated.

DIAMOND sales will be curtailed, not only by the general decrease of luxury, but because the cutting is chiefly done at Amsterdam, close to the scene of war.

THE BEST asset in the world today is a gold or silver mine. The precious metals have appreciated, as credit has depreciated, by our relapse into barbarism.

IN our Discussion department we publish an interesting letter from Mr. Alfred James. It was printed before the great unpleasantness began. In happier times we shall take steps to utilize his suggestion.

A CARGO of zinc, cyanide, and mercury, on board the German steamer *Hansa* is detained at Luderitzbucht, in German Southwest Africa. We trust that this ship

will be expedited to its destination in South Africa.

BROKEN HILL will be hard hit by the war as far as zinc production is concerned, for practically the whole of the zinc concentrate has been treated hitherto in Belgium and Germany. Only two companies, the Proprietary and the Sulphide Corporation, have ever attempted the production of metallic zinc, the first named on the spot, and the latter at Seaton Carew in England. Neither of these projects has been a success, for their expansion has been checked by the lack of suitable labour. As regards the lead concentrate, a large proportion is smelted in Australia. Some of the companies ship to Germany, and of these the British and South have had to close-down their mines.

A TOUCH of humour is injected into the stern realities of the moment by the announcement that the Frank Smith Diamond Estates company has closed-down "owing to the political situation in Europe and the financial outlook." The simple fact is that the new washing-plant has failed to do its duty, and the yield of diamonds is insufficient to meet expenses. The European imbroglio, the Lord knows, has enough to answer for; it is not necessary to saddle it with a diamond-mining company's fiasco.

IN an article appearing in the *Mining and Scientific Press* of July 11, Mr. Philip Argall makes a notable contribution to the economic geology of Leadville, for he gives further proof that the manganese ore originates from the siderite or 'black iron,' as previously outlined in our April issue. He has suggested the similar origin of the Breece Hill hematite. Further, by describing a genuine case of contact metamorphism as a characteristic of the upper ore horizon at Leadville and the existence of a pre-mineralization fault, he has dis-

tinctly advanced the good work done by the late S. F. Emmons and his assistant, Mr. J. D. Irving, now professor of geology at Yale. We welcome such work as Mr. Argall's. To such acutely observant mining engineers, economic geology is largely indebted; and it is a debt we are not loth to place on record, because it is sometimes ignored, sometimes depreciated, by official geologists.

MERCURY is another chemical important in the treatment of the precious metals. Of the total output, which amounts to about 4300 tons, one third comes from the provinces of Ciudad Real, Granada, and Almeria in southern Spain. Most of the remaining two-thirds of the world's supply is derived nearly equally from Idria in Austria, Monte Amiata in Italy, and the counties of Santa Clara and San Benito in California. It is probable therefore that the price of quicksilver will rise, and that the mining of cinnabar, the sulphide of mercury, will be stimulated in Spain and California, particularly the latter.

WE take pleasure in publishing a remarkable piece of evidence regarding the origin of oil, based upon data obtained in the Red Sea. The geological part is the work of Mr. Arthur Wade, D.Sc. (London), while the chemical investigation was made by Mr. S. Roy Illingworth, B.Sc. (London), A.R.C.S. They have joined in co-ordinating their knowledge in the form of a most interesting paper, which goes far to prove that oil can originate from the decomposition of bacteria in marine mud.

TELLURIDE IN ONTARIO is made the heading of a paragraph in a financial paper, which claims credit for the announcement. Compounds of tellurium and other metals are common in mining districts, although it is not often that they are found in economic quantity, as in Cripple Creek, Kal-

goorlie, and Transylvania. The idea that the association of tellurium with gold presages persistence in depth has been exploded long ago. The presence of tellurides in precious-metal ores is apt to create a metallurgical difficulty, and the existence of such minerals in the ore is of geological interest, but no more. These highly lustrous minerals have been the excuse for a great deal of flapdoodle.

OIL SUPPLIES will be affected by the war, for Galicia produces about 2% of the total crude oil production of the world; Rumania, which is on the edge of the war, contributes 3½%; in Russia, the two Caspian oilfields of Baku and Grosny are responsible for 14 and 2½% respectively. Shipments from all of these are certain to be affected. Galicia is on the Austrian frontier, and may suffer directly from warlike depredations. The Dutch and British Indies contribute 6% and 3% respectively, and the supply from them will be delayed by the uncertainties of ocean travel in time of war. However, the American supply, equivalent to 64% of the whole world's output, is available as soon as the Atlantic has been cleared of German cruisers.

CHANGES OF ADDRESS are often significant. We note that the offices of the Camp Bird, Santa Gertrudis, Esperanza, Messina Development, and Central American Goldfields Syndicate have been moved from 3, Princes Street to No. 1, London Wall Buildings, that is, from the quarters of Mr. Arthur M. Grenfell to those of Mr. Herbert C. Hoover. We are glad to add that Mr. Arthur A. Kelsey remains the secretary of the Camp Bird, Santa Gertrudis, and Messina companies, as well as a director of the Esperanza company.

RELIABILITY of reports is discussed by one of our contributors, Mr. Eric J. Starey. With much of what he says we

agree, for we also are loth to pillory any member of the profession. Those criticized in connection with the Juga affair have had the chance to make a statement in our columns, and thereby clear themselves in the eyes of their fellow practitioners. Certainly the reports of the younger men ought to be *visé* by an older consultant, in order to guard against such errors as have marked Nigerian tin enterprise. We have laid the principal blame at the door of the board-room, where young men of inadequate experience have been engaged for small fees to make reports that subsequently have been used as the opinions of veteran experts. That has been the curse of Nigerian development and explains many of the disappointments.

THE INSTITUTION of Mining and Metallurgy, by its President and Secretary, has taken the necessary steps to organize a volunteer corps of members and associates. The offer has been received by the War Office in the most appreciative spirit, the Army Council having expressed its sense of the value of such "a corps of experts" for defensive purposes. We shall not mention names; it suffices to say that over 150 enrolled themselves within 24 hours of the call for volunteers, and that among them were several Anglo-American engineers honourably prominent in the profession. The value of such an expression of support to the Government, and the cause of civilization in Europe, depended on its promptitude. By its instant patriotic action our Institution has won a charter more royal even than that which will be granted shortly, we hope, by His Gracious Majesty, the King.

Effects of the War.

As mining, in its worldwide aspect, is dependent upon the supplies of capital, machinery, material, and labour, it follows that serious interference with operations must en-

sue at once. The mines in course of development will suffer for lack of capital, and those that are productive will restrict exploratory work. The demand for gold may stimulate the supply of the metal on which war is nourished. Silver will be in demand for small coinage. As to the base metals, the effect of the war is uncertain. Bullets and other projectiles involve the waste of lead, and nickel also. Copper will suffer at first, but the use of it in warlike apparatus of all kinds, afloat and ashore, will be felt at a later stage. Zinc, as a constituent of brass, is used in war material to a large extent, and, owing to the closing-down of the German and Belgian smelters, must appreciate in value. The metal market will be rendered chaotic for a time. The markets for machinery and supplies will be shifted with the exigencies of the moment. America, eventually, will benefit enormously. As to labour, the call to the colours will affect many mines out of Europe, but the damage will be small, for it will have ceased with the commencement of hostilities, it being impracticable to import military labour once the seas around Europe are swarming with hostile cruisers. In Russia the domestic market for copper is guarded by a bonus that has the effect of an export duty, so that there the conditions are favourable. Many of the Russian members of the staffs at the big Siberian mines will have been drawn to military service, and to this extent operations will be impeded for a time, but the supply of native unskilled labour, chiefly Kirghese, is not likely to be affected. The closing of the German and Belgian smelters will injure zinc-mining companies, as well as the Burma Corporation, which lately found a Continental market for its complex zinc-lead ore. The local smelting of Broken Hill zinc concentrate may be stimulated by the closing of the Continental smelters. The tin ores that used to be treated in Germany will be diverted to Liverpool. Similar derangements and shiftings of business will be

reported from every direction, but if the trade-routes are kept open, by the dominance of the British navy, it is likely that there will be a gradual restoration of orderly conditions. Unquestionably the vital factor to the world's trade, especially between London and the regions irrigated by British capital, is the maintenance of a clear way over the seven seas. The hand that holds the trident rules the waves.

Mining in Belligerent Europe.

The war suggests an inquiry into the size and character of the mining industries of the countries immediately affected, namely, Great Britain, France, Belgium, Russia, Austria, Germany, and Italy. All of them produce coal and steel, the staples of industrial civilization.

| | Coal. Tons. | Steel. Tons. |
|-----------------------|----------------|-----------------|
| Great Britain | 270,000,000 | 6,700,000 |
| France | 42,000,000 | 4,000,000 |
| Russia | 24,000,000 | 2,500,000 |
| Belgium | 23,000,000 | 2,400,000 |
| Germany | 260,000,000 | 17,000,000 |
| Austria-Hungary | 48,000,000 | 3,000,000 |
| Italy | 360,000 | 650,000 |

| | Lead. Tons. | Copper. Tons. | Zinc. Tons. | Tin. Tons. |
|--------------------|----------------|------------------|----------------|---------------|
| Great Britain..... | 25,000 | 450 | 59,200 | 19,000 |
| France..... | 33,600 | — | 65,000 | — |
| Russia | 1,000 | 45,000 | 9,000 | — |
| Belgium | 55,000 | — | 206,000 | — |
| Germany..... | 165,000 | 24,000 | 285,000 | 12,500 |
| Austria-Hungary .. | 20,000 | 4,000 | 18,000 | — |
| Italy..... | 21,000 | 1,600 | 500 | — |

It is clear that Great Britain and Germany are in a class by themselves as compared with the others. As regards the base metals, it will be seen that Germany is much the most important statistically, this being due to the fact that Broken Hill zinc concentrate is smelted in Rhenish Prussia while Bolivian tin concentrate is smelted at Essen and Hamburg. Of the tin produced in Great Britain, 5000 tons is from domestic Cornish ores and 14,000 from imported concentrate, chiefly from Northern Nigeria, Bolivia, and South Africa. Of the British lead, 17,500 tons is from domestic ore. France receives zinc ore from Algeria, while the Sardinian zinc ore,

which ought to be credited to Italy, goes to Belgium for treatment. Broken Hill sends a large part of its zinc-lead concentrate to Belgium. The German copper output is derived mainly from the Mansfeld Copper Company, which produced 20,500 metric tons in 1912. The Russian copper comes from the Urals, the Caucasus, and Western Siberia. The region last mentioned promises to become the most important. Servia produces about 7000 tons, chiefly from the Bor mine, operated by a French company. Italy's lead and copper production is due largely to the custom smelting at Pertusola and Monteponi. On the whole, it is apparent that the base-metal mining of the Great Powers is of relatively small importance, and that the actual output of metal is due mainly to the smelting of ores from distant regions. To compare the outputs of the seven countries, we append the world's production of the base metals, in metric tons :

| Lead. | Copper. | Zinc. | Tin. |
|-----------|-----------|-----------|---------|
| 1,000,000 | 1 100,000 | 1,200,000 | 130,000 |

The curious coincidence will be remarked that the total production of lead, copper, and zinc is in each case about a million tons.

As regards the precious metals, the Russian output of gold is the most striking item, but it is derived from the Asiatic portion of the Czar's dominions, the nearest mines being those in the Ural mountains, on the Siberian border. The following figures give the production in pounds sterling :

| | Great Britain | Russia | France | Belgium | Germany | Austria | Italy |
|--------|---------------|-----------|---------|-----------|-----------|---------|--------|
| Gold | 60 | 5,500,000 | 400,000 | — | 650,000 | 450,000 | 3,000 |
| Silver | 56,000 | 37,000 | 165,000 | 1,000,000 | 1,600,000 | 225,000 | 35,000 |

The notable production of silver in Germany is derived chiefly from the smelting of zinc-lead concentrate from Broken Hill and ores imported from South America. The copper ore of Mansfeld yields silver and is the chief domestic source of the metal. France has three or four productive gold mines, while the Austrian output comes from the ancient mining region of Transylvania. The Belgian

silver production is entirely from imported ore and concentrate, chiefly from Broken Hill. As compared with these seven European countries, omitting the Siberian part of the Russian empire, we may compare the precious-metal production of Mexico, a country recently devastated by war, and in which the normal output of gold is £4,500,000, with £9,500,000 worth of silver, together making a total of £14,000,000 as against a total of about £2,000,000 from the European territories of the seven Powers. On the other hand, a war in Europe affects metal mining in its world-wide phase by withdrawing supplies of skilled labour, by stopping the flow of capital for expanding enterprise, by paralysing the metal markets, and by crippling the manufacture of the necessary supplies.

Cyanide Supply.

Fully one-half the supply of this chemical is made in Germany ; but more than a half of the cyanide used in South Africa comes from the country with which Great Britain is at war. In 1913 the Rand alone consumed 10,167,934 pounds of cyanide, valued at £424,831. We are glad to say, however, that the supply on hand at Johannesburg will suffice for two or three months, pending new arrangements, while the amount of zinc for precipitation is enough for three or four months, at least. The price of cyanide has been kept low, by German and English manufacturers, at 7 pence per pound, in order to discourage the production of the chemical at gas-works. If the price goes up to 9 pence, the English supply would suffice for any conceivable demand. The trade has hinged on 'the parity of prussiate,' that is, as to whether it is profitable for gas-works to sell their hydrocyanic acid in the form of the prussiates of potash and prussian blue, or as cyanide. Every rise in the price of the latter offers an incentive to the manufacture of it as a by-product in gas-making. The Castner process,

patented in 1894, involves the passing of ammonia over sodium heated in an iron retort, yielding sodamide, which is brought into contact with red hot charcoal so as to be converted into sodium cyanide. In gas-works, hydrogen cyanide is a constituent of the gases evolved, and is caught on the iron oxide used for extracting the sulphur from sulphuretted hydrogen. Methods also exist for utilizing the ammonia in illuminating gas, coke-oven gas, and blast-furnace gas for making cyanide by the Castner process. As regards zinc, the supply has come largely from Germany and Belgium, but the small quantity used in cyanidation can be obtained readily from America, if the sea-ways are open.

Gold and War.

The yearly gold production of the world at the present time is worth about £94,000,000. Of this total amount the British Empire furnishes nearly two-thirds. We give the latest available statistics:

| | |
|---------------------|-------------|
| Transvaal | £37,000,000 |
| Rhodesia | 2,900,000 |
| West Africa..... | 1,600,000 |
| Australasia | 11,000,000 |
| Canada..... | 3,100,000 |
| India | 2,300,000 |
| British Guiana..... | 600,000 |
| British Borneo..... | 300,000 |
| Miscellaneous | 200,000 |

£59,000,000

The only important gold-producing countries not under our flag are the United States, Russia, and Mexico, which yield £17,500,000, £5,500,000, and £4,000,000 respectively, per annum. In Mexico the production this year has been crippled by the brigandage incidental to a revolutionary war, which, however, appears to be at an end, for the present, at least. The gold mines of Russia are chiefly in the Siberian hinterland, none of them being situated near the seat of government. It is a re-

markable fact, therefore, that the production of the gold so essential to warfare is not directly affected by armed conflict between the Central European countries. The indirect effects of such a relapse into barbarism, with its destruction of credit and devastation of commerce, are felt, of course, in the uttermost corners of the earth, by stopping the flow of capital so essential to business and withdrawing the labour that is the primary machine in mining as in other departments of human industry.

The Stock Exchange.

On July 31 the London Stock Exchange was closed for the first time in its history. While the custom of dealing in shares started with the creation of the National Debt under William III, and was greatly stimulated by the boom in South Sea Company shares, it was not until 1773 that the Stock Exchange was organized. For nearly a hundred years before that the dealers in shares used to do their business in the public streets, like the New York curb market and our own Throgmorton Street after the regular dealings are at an end. In those days they used to meet in Change Alley and Lombard Street, or about the Royal Exchange and in the rotunda of the Bank of England. They became such a nuisance that they were expelled from the purlieus of the Royal Exchange, whereupon they took refuge in the coffee-houses. Of these old Jonathan's in Change Alley became the chief. After it was burnt down in 1748, the New Jonathan's coffee-house was built, and in July 1773 the brokers and jobbers that made regular use of it for their business arranged to call it the Stock Exchange. This name was put over the door, rules were devised, and sixpence was charged for admission. The business grew to such an extent that in 1801 it became necessary to stop the general admission of the public. A group of leading brokers raised £20,000 in £5 shares,

purchased a site in Capel Court that had been occupied formerly by a boxing saloon conducted by Mendoza the Jew, and erected a special building for the first Stock Exchange. Business was largely confined to the 'funds' or Government securities, but the scope of transactions was speedily enlarged when the Napoleonic wars came to an end and an era of industrial expansion supervened. Foreign loans, canal and mining shares, and then the great railway mania, led to a great development in stock speculation. Then came the South African mining market, the rubber and oil boom, and a multitudinous range of dealings in scrip of all kinds.

Economic and Otherwise.

We note with interest the announcement that the governors of the Imperial College have appointed Dr. C. G. Cullis to the professorship of Economic Mineralogy. This is an excellent appointment. It is interesting because it concerns the Royal School of Mines, now a constituent part of the Imperial College. The use of the term 'economic mineralogy' is worthy of remark, as indicating an official recognition of the commercial phase of an important subject. Even without the qualification we should have assumed that the mineralogy taught in a school of mines is intended to have an economic application. And, if so, it becomes applied geology, for minerals viewed qualitatively only have no economic interest; it is quantitatively that they become important to the arts. However, there is reason to be grateful for this official recognition of the utilitarian side of a fascinating subject. We remember when Roberts-Austen taught metallurgy as if it were metallography, and lectured to students as if they were an audience of not incurious curates, instead of keeping an eye on the purpose of their teaching, which was, and is, to extract metals out of ores for the use of industry. Time was also

assembled periodically to talk and write on fossils and correlations, as if geology were soiled by connection with gross money-making or the giving of light to the miner underground. The time may come when the teaching of science at South Kensington will be economic in its fullest sense, and it will be realized that the training of effective men is the most economic of all sciences. When that time comes, it may dawn on some of the mandarins in control of the Educational Department that the British Empire was developed in the wake of the miner and that its future stability must depend on a wise and skilful use of its varied mineral resources. Not admirals and sailors, but miners and prospectors blazed the trail of empire, and carried the flag into the waste places of the earth, for the eventual up-building of great British communities across the seven seas. As yet, this historic fact is ignored. The Empire has not got one well endowed and thoroughly organized School of Mines. It has one that has been pushed from pillar to post for 63 years, and is now in danger of being driven from its last anchorage into the vast morass of a pretentious university agglomeration. 'Economic' is not a word to use in connection with the story of the Royal School of Mines. From being a Government School of Mines intended to promote the education of those engaged in one of the two basic occupations of our people, it has become a subordinate part of a grandiose scheme, and is now in danger of being smothered amid a still further glorification of red tape. 'Economic,' forsooth! we are the least economic people on the face of the earth, from mineralogy to education. Proud of our public schools and universities, where our privileged youth obtains a manner that is charming and a training that is unavailing, we ignore the historic technical school where ought to be trained the men on whose directing skill depends the production of those metals by the use of which civilization is spread to every

corner of our hard-won dominions. We endow schools for the clergy, the army, and the navy, but we neglect to make proper provision for the training of those who, more than any missionary, soldier, or sailor, have blazed the trail of civilization and pioneered the advance of empire. The mere statement, literally and pitifully true, expresses a fact so little recognized that to the average citizen it sounds a bit of bathos. To us, and others familiar with mining and the history of mineral development, the need to use 'economic' to indicate the utilitarian employment of mineralogy in the latest metamorphosis of our School of Mines, is as pathetic as the fact that in the House of Commons the preservation of pretty birds and the protection of old horses awakens more interest than the effort to bring our Royal School of Mines from passing under the control of an academic senate and a doctrinaire administration in the name of a University that assumed teaching functions the day before yesterday.

Mysore Gold.

The sudden drop in the share quotation and the official statement ensuing have drawn attention to this famous Indian mine, which has paid £7,414,344 in dividends to its shareholders. According to the circular of July 23, nothing has happened since the annual meeting to warrant special anxiety concerning the future of the mine. At that meeting it was mentioned that the Ribblesdale and McTaggart orebodies showed impoverishment, but this, it was said, only exemplified "the fluctuations in value pertaining to reef mining, of which, in its long history, the Company has had previous experiences." The Tennant orebody, moreover, "has continued to open-up high-class milling quartz." In short, "the falling off in productiveness" was said by the directors to be "temporary only." The reserve of ore is given as 1,377,102 tons, but these figures have no technical significance in

the absence of any mention of the grade; it is not even made clear that this ore is of the average now being milled, although that may, we think, be assumed. Now, we have not the slightest reason to question the good faith of these statements; the mine has had lean periods before now, and such periods have been followed by a recovery more than sufficient to restore its former productivity, so that a reasonable measure of optimism seems warranted on the part of the directorate. Moreover, the shareholders have never failed loyally to support a management that has repeatedly proved its integrity and skill. But these very conditions, so creditable to all concerned, have, we think, led to unjustifiable expectations concerning the persistence of the ore in depth. Impoverishment at 4000 feet is not the same thing as impoverishment at 400 feet in depth; the illness of a man at 25 is not the same thing as illness at 65 years of age; in other words, complete recovery from impoverishment becomes less likely as a mine attains great depth. No theory need enter into the question; it is one of world-wide experience. But there is another factor, to which we draw attention with no particular pleasure, namely, that the orebodies of the Mysore mine are ore-shoots pitching strongly northward. It is this pitch, or inclination on the plane of the lode, northward at an angle of 40 to 45 degrees that has caused the idea of zones of relative impoverishment and enrichment to be entertained. A vertical shaft, for example, will pass out of one ore-shoot into barren ground, and then into another ore-shoot, because it crosses the trend of the orebodies, which, looking east, slope downward at a flat angle to the north. On that side is the Champion Reef boundary. Indeed, the Tennant ore-shoot passes into this neighbouring mine between the 2000 and 2800-ft. levels. The other two main orebodies will also pass out of the Mysore ground in depth, should they persist long enough, of which there is insufficient

evidence. On the other hand, no fresh ore-shoots have been found proceeding from the south, for the ground adjoining the Mysore on that side is, as far as known, no good. It is this absence of new ore-shoots coming from the south, and under those already exploited, that raises grave fears concerning the future productivity of the mine. These facts are plainly recorded on the longitudinal section published annually with the company's report. It is nothing new that we have unearthed. Any mining engineer can see for himself that our inference is incontrovertible. The shareholders have had this information, year after year, but they seem to have ignored it. In April last year, in these pages, we discussed the future of this splendid old mine, and said that the expectation of life indicated by the market valuation, with shares quoted at £5½, was too high. We are content to leave it at that.

Rand Problems.

The latest report of the Dominions Royal Commission deals with the future of the world's greatest goldfield in a spirit of large sagacity. It accepts the technical opinion of the four engineers employed by the recent Economic Commission that the producing mines of the Rand can still furnish 550,000,000 tons of ore; that the present rate of crushing—28,000,000 tons per annum—can be maintained for 5 years; and that subsequently the output will decrease so that by 1930 the tonnage will be one half of what it is now. This estimate does not assume any lessening of cost; as a matter of fact, we may anticipate that it will decrease, so that the so-called working cost will represent the real expense incurred. The cost quoted by the Commission represents about 85% of the total cost. It is curious how the fallacious statistics of the Chamber of Mines are allowed to mislead shareholders, the press, and these commissions of inquiry. The 'working cost' is not the total cost of

working a mine. Next, we find that a depth of 7500 feet is arbitrarily taken as the limit of remaining undeveloped ground; not because the mines are assumed to become unprofitable at a deeper horizon, but because the Mines Department has intimated its unwillingness to consider the proclamation of ground—that is, the granting of permission to locate mining claims—in which the Main Reef series exists at a greater depth. This will suggest to untechnical persons, we fear, that the same authority assumes therefore that the lode will be profitable to that depth. No such assumption is involved, but the estimate mentioned does take it for granted that the lode down to 7500 feet vertically will yield ore equal in tonnage and value to that obtained in "the last 1000 feet of all workings throughout the length of each mine." This we deem technically incorrect. A mining engineer who made any such cool assumption when appraising a particular mine in any part of the world would be deemed unwise. The Rand is not unique as regards persistence of ore; it is subject to the usual limitation. On the other hand, we have the estimate furnished by Mr. R. N. Kotzé, the Government Mining Engineer, to whose special knowledge and good sense we readily defer. He puts the tonnage of the producing mines at 587 million tons, and so differs but slightly from the earlier estimate. He expresses future prospects in another way, however; he expects that by 1924 twenty-five mines now producing £10,000,000 annually will cease operations; by 1934 a further thirteen, now producing at the rate of £10,500,000, will have stopped; and by 1944 nine more, now producing £7,500,000, will be exhausted. Thus within 30 years the output from the existing mines will have fallen from £36,000,000 to £8,000,000. But he suggests large possibilities in the undeveloped areas on the outskirts of the productive ground. Out of 114,500 untested claims that do not belong to the producing mines, he considers that

31,400 claims may prove exploitable. These may contain 600 million tons, as compared with the 230 millions already mined and the 587 millions yet to be extracted from developed ground, making in all 1417 million tons of positive, probable, and possible ore to be yielded by the Witwatersrand. These figures, we suggest, have a more direct bearing on the future of the industry as a consumer of supplies and an employer of labour than on the income to be derived from the capital that has been, and may be, expended. Private and joint-stock finance may well hesitate at the prospect of incubating enterprises from which the Government will exact all that labour leaves unclaimed. At the present time, the Union Government derives £12,000,000, or 45% of its total revenue, through the Rand, as against £8,000,000 paid to white employees and £8,000,000 paid to shareholders. This last sum looks small in view of the fact that the capital involved is about £85,000,000. An amount equal to one third of the gross output finds its way to the Government. It looks as if there were a margin for considerable and considerate reduction.

The Commissioners appear to consider a general scheme of consolidation, a Witwatersrand Limited, to operate all the mines on the Main Reef series, as within the sphere of economic possibilities. Such a vast conglomeration has been suggested to them as a means of increased efficiency, harmonious control, collective bargaining between capital and labour, security of investment, and so forth. To this we can only say, as we have said before, that the big consolidations already effected have over-taxed the ability of the controllers. Super-mining enterprises are easier to create than the super-men to manage them. Beyond that, the reduction of the Rand industry to a unit corporation would kill the speculative interest normal to mining; before the market valuation could be reduced to an investment basis, it would be necessary to

squeeze so much water out of the shares as to cause a sudden and enormous loss to the present proprietaries. The day may come when the Government may find it desirable to become the sole proprietor and operator of the Rand, but that consummation is one not to be desired, and it is not likely to supervene until it becomes an economic necessity, namely, when public interest has been extinguished and it becomes necessary to keep the industry alive for the sake of the State. Meanwhile, we note the suggestion of the Dominions Royal Commission that an outside independent technical authority of the highest standing should be invited to investigate, after the manner of Surgeon-General Gorgas's recent visit and recommendations. The proverb says that "advice is cheap," but, like most proverbs, its reverse is equally true. Good advice is priceless. A commission of three technical men of world-wide experience should be able to aid the Union Government and the Chamber of Mines. In South Africa politics and mining have formed an unnatural union, injurious to both. Local views are likely to be warped. The opinions and suggestions of three experts wholly detached from local and provincial prejudices ought to be of far-reaching value to the industry on which South Africa so largely depends.

Lindley on Mines.

On another page, and in its proper place, we publish a review of the authoritative treatise on mining law in America. This is the third edition of a monumental work that appeals not only to the legal but to the mining practitioner. In the United States the problems arising from the application and interpretation of the mining regulations have hinged so frequently upon the geological phase as to cause the lawyer to co-opt the engineer of mines, as well as the specialist in economic geology. The result has been to extend the knowledge of each profession, to their mutual gain. As

regards the mining industry, it may be said that the burden of litigation has found some compensation in such elucidation of rock-structure as has facilitated the finding of ore. The workings extended merely to prove or disprove the continuity of a given vein, the existence of a fault, or the width of an outcrop have led more than once to the uncovering of unknown orebodies. This is true particularly of such districts as Butte, Aspen, and Bingham, where the law of the apex has proved hard to interpret. It is fair to say that the fundamental concept of the American law grew out of the little knowledge that is proverbially so dangerous. Starting with the idea of a vein as a regularly tabular body of ore deposited in a continuous nearly vertical fissure—the 'true fissure-vein' of the kindergarten period of mining geology—the early framers of local regulations hastened to give the owner of a given length of outcrop the right to follow his vein on its dip to unlimited depth, and in total disregard of the surface rights of his neighbours, who, it was presumed, would be neither inconvenienced nor impoverished by his deep digging. They, in turn, had the right to follow any vein outcropping on their claims in a similar way. If it had been ordained that veins should be so parallel as never to meet or to discontinue when a chance of interference was imminent, then the law of the apex would have been all that could be desired as a means of apportioning the privileges of the prospector or of the mine-owner that might follow in his foot-steps. But Nature is complex. Veins have a way of changing their dip in harmony with structural conditions; they dip variously; they intersect; they merge into one another; in short, the vagaries of vein-structure are far beyond the limits of a legal definition, much more the elementary regulations of an unscientific digger. In Australia and Mexico, the sailors and muleteers who began the mining of gold and silver were too ignorant of geology, even of the schoolroom

kind, to keep one eye on the ground and another on a text-book; hence they contented themselves with the subdivision of mineral land in terms of the sunlit surface only, and did not undertake to foresee how their lode or vein might behave in the darkness underground. They found troubles of their own, it is true, but they escaped the intricate litigation that has taxed the American mining industry in consequence of the endorsement of the California miners' regulation of 60 years ago that the possessor of a claim had "the right to work the vein to an indefinite depth, regardless of the occupation or possession of the surface underneath which it might penetrate, and to hold, in connection with the main vein, without regard to any enclosing surface boundaries, the 'dips, spurs, angles, and variations' of the located vein." So says our author, the leader of the San Francisco bar and the first authority on the subject. It is true, in several districts this procrustean regulation was modified by mutual consent as between neighbours, who desired to avoid a quarrel. At Leadville and Aspen, where orebodies in beds of limestone rendered the apex law ridiculous, such agreements were plainly required, but in other regions where similar deposits were found in up-tilted sedimentary formations, the absurdity of the early miners' notions of lode-structure was not so obvious, and vast sums of money were spent in the courts, as, for instance, in connection with the mines of Eureka, in Nevada, and Park City, in Utah. These experiences, as might be expected, have led to a growing demand for a modification of the law. The matter is now the subject of agitation before Congress, under the leadership of a skilful engineer-geologist, Mr. Horace V. Winchell, formerly consulting geologist to the Anaconda Mining Company. Toward this reformation Judge Lindley has given wise counsel, and in his treatise will be found all the evidence required to prove the necessity for framing a law that is not crippled

by being tied closely to the eccentricities of ore deposition. To the geologist, we commend such a treatise as this because it gives him an exposition of geological structure in terms of precision. Our friends the lawyers can make any but the soundest of geological disquisitions look sheepish, and when the best of them undertakes to express the salient facts of rock-structure he can do it with a clarity that is a delight to those able to appreciate the difficulty of employing words as a means of thought transference. So we thank Judge Lindley for this book, which appeals to us also on other and more personal grounds. When San Francisco was devastated by the conflagration that followed the earthquake in April 1906, the volume of smoke that rose two miles high above the city by Golden Gate was enriched by the products of combustion from the burning of the voluminous notes and emendations, nearly completed, for a third edition of 'Lindley on Mines.' The present edition, therefore, exemplifies not only the continued study and research of a learned author, but it is a proof of the ability of the human spirit to triumph over ruin and disaster. Not buildings only have been rebuilt in San Francisco.

Crown Mines.

Attention has been drawn to this big enterprise by a vigorous speech from the chairman of the company, Mr. Samuel Evans. He referred to the original forecast and claimed that it had been fairly fulfilled, making allowance for the unexpected shortage of labour. We are inclined to agree. The consolidation was effected in 1909, and included the Crown Deep, Crown Reef, Robinson Central Deep, and Langlaagte Deep, all producing mines, to which were added several groups of claims acquired in exchange for shares, making in all 2200 claims, of which 1979 were intact on June 30, 1909. The average working cost at the four principal mines was 15s. per ton in November 1908. A reduction in working cost was

promised at a rate greater than would have been possible if the absorbed companies continued working as separate units. It was confidently expected that dividends of 130% per annum would be paid to shareholders. A total annual yield of £2,970,000 in gold and a working profit of £1,398,000 were foreshadowed. Let us put the figures side by side.

| | Forecasts | Actualities |
|---------------------------------|------------|-------------|
| Yield | £2,970,000 | 3,248,132 |
| Working profit | 1,398,000 | 1,442,473 |
| Proportion of profit to yield.. | 47% | 44% |
| Working cost | [13s.] | 16s. 5d. |
| Working capital required..... | £500,000 | £1,468,000 |
| Dividends..... | 130% | 110% |

It was indicated that an expenditure of £500,000 would be required to bring the consolidation to full fruition, the capital for this purpose being provided by the accumulated funds of the constituent companies. Instead, a sum of £1,468,394 has been spent, and a debenture issue of £1,000,000 has proved necessary. No exact forecast of working cost is recorded, but the assurance that the decrease would be accelerated, taken with the statement that it was 15s. in November 1908, warrants us in expressing the expectations then adumbrated by the figure 13. While the reserve in 1909 was 4,482,000 tons of ore, averaging 7'94 dwt. per ton, it has been increased, at the close of 1913, to 10,449,000 tons averaging only 6'82 dwt. per ton; but the decrease in grade is due mainly to the inclusion of a large tonnage of banket not likely to be mined unless the cost is considerably reduced. Meanwhile, 1868 claims remain intact. Last year the 32 claims exhausted yielded 2,195,600 tons of ore, being at the rate of 68,000 tons per claim. This, on paper, indicates a life of 50 years, crushing 2,500,000 tons per annum. It may be compared with Mr. G. E. Webber's estimate, dated January 1, 1909, of a life of 50 years at 2,000,000 tons per annum. Allowing for the 5 years that have passed and the increased output, Mr. Webber's estimate would now represent 35 years more of life at

full capacity. This, it appears to us, is likely to prove more nearly correct than the "40 or 50 years" usually quoted. While the workings of the group are not the deepest on the Rand, we see no reason for anticipating any deviation from the general experience of impoverishment in depth; in other words, we deem it rash to expect the same yield of profit per claim from the claims intact as from those already exhausted. Meanwhile, it must be acknowledged that the luck has been against this fine enterprise. Mr. Evans states that a burden of 2s. 6d. per ton has been imposed by the limitation of hours underground, the charges arising from phthisis, sand-filling and other measures of safety, as well as the extra supervision underground enforced by new regulations. What shortage of labour means is indicated by the fact that the difference to date between the quantity of ore milled and the full capacity of the plant is equivalent to 2,292,000 tons, representing a probable profit of £1,300,000, all of which, of course, is still in the ground, losing interest, however. On the other hand, it is pleasant to note that, owing to the increased employment of machine-drills in stoping, the efficiency of native labour has increased from 12·3 tons per man in 1911 to 16·4 tons per man in 1913. Moreover, the terms of employment have recently been made more favourable to machine-drillers, so as to incite further improvement. As regards some of the labour restrictions and the phthisis impost, it may be allowed that they belong to the category of the unexpected, but the sand-filling, timbering, and rock-walling are among the items normal to extensive excavations underground. Indeed, we go so far as to say that in planning any enterprise of such magnitude as the Crown Mines, with operations lasting for so long a period as half a century, it is necessary to make an allowance for unseen contingencies. All big mines are likely to suffer seriously at some time in their career from labour troubles, fire underground, sub-

sidence of rock, and interruption to the continuity of the orebodies. These are among the risks of mining; they are among the possible factors militating against uniform productivity; on account of them mines are expected to pay a high rate of interest. While the Rand has made a superb record, it has provoked assumptions of an optimistic character, from indefinite persistence of ore in depth to unlimited supplies of labour.

Tanganyika Concessions.

"Age cannot wither nor custom stale the infinite variety" of Mr. Robert Williams's optimism, and this we say not with a sneer, but with admiration. Indeed, he reminds us of another captain of industry, the late W. C. Greene, of Cananea fame, the man who did more than anybody else to develop that great copper deposit in Sonora, as well as other mining districts on the Mexican border. While the Rhodesian operator is a man of more education than his American prototype, they are alike in their invincible optimism and indomitable energy. Their careers likewise exhibit the same failing: the dislike or hesitation to acknowledge limitations of capacity; so that both of them undertook to lay out intricate technical operations, without adequate knowledge, experience, or advice. Both, however, win our admiration as pioneers of industry. They broke the trail for enterprise, and originated mining and metallurgical operations on a large scale. If Colonel Greene had engaged Mr. L. D. Ricketts at the start of his work at Cananea, instead of doing so at a late date, and if Colonel Williams had retained Mr. Archer E. Wheeler as soon as the metallurgical equipment at Elisabethville was contemplated, instead of doing so when the first smelter had proved misplaced and unsuitable, both of them would have saved much time and money. In reading the speech made by Mr. Williams at the recent meeting, we see his weakness and strength alike illustrated.

Without apology he quotes from a letter, written in 1902, to the Minister of Finance of the Congo State, in the course of which he speaks of the Kambove and Likasye as the "richest copper mines in the world"; he undertakes to produce 1000 tons of copper per day, and to land it in England for £24 per ton. Twelve years have passed and the mines he mentioned are in the same second-class as half a dozen we could cite; they yielded 7000 tons of copper, or 20 tons per day, in 1913; to be delivered in Europe for a total cost of £42 per ton. So much for the optimism; now for the performance. He has been the guiding and informing spirit of an enterprise that has caused a continental railway to be built from Tanganyika to the west coast, and a connection to be made with the Rhodesian system leading to the east coast of Africa. He has developed some extensive ore deposits, built a smelter, and begun the production of copper on a considerable scale. He has incited the development of the Wankie coalfield near the Zambesi, the making of coke suitable for smelting, and the successful search for other coal resources nearer Katanga. He has opened a vast mineral region, made a way for business in the heart of Africa, and laid the foundations of industrial civilization in one of the blank spaces of the map. Meanwhile, time and money have been consumed lavishly. To an invincible optimist both are minor factors, but to the economist both, when used freely, tend to impair the fruitfulness of capital. We are not without sympathy with this mineral adventurer, using the word in its Elisabethan and spacious sense, but, viewing the matter from a business standpoint, we recognize the inherent weakness both of the founder and of the enterprise, in that so little information is given or obtainable concerning the actual technical work at the mines and smelter. The estimates of Mr. Williams are interesting, but they are those of a promoter, and of one committed to pre-

vious estimates. We would like to see publicity given to the reports and expectations formulated by engineers having special knowledge of copper mining and metallurgy. Of late, several particularly competent men have been concerned with the Tanganyika enterprise. Why are their reports not published? We have no reason to suppose them to be unfavourable, and we feel sure that, if favourable, they would allay the anxiety natural to shareholders who have waited so long for a return from their speculation.

Meanwhile, the Union Minière du Haut Katanga, the actual operating company, in which the Tanganyika Concessions holds a 40% interest, made a profit of £108,000 last year on an output of 7000 tons of copper. This year it will produce probably about 12,000 tons, although Mr. Williams, in characteristic fashion, uses the higher of the alternative estimates, and forecasts an output of 14,000 tons. He states that, if the price of the metal remains steady, the Belgian company will earn from £1,800,000 to £2,000,000 in profits in the next three years. But Mr. C. F. Rowse, the chairman, stated at the Zambesia Exploring meeting that the Tanganyika Concessions, in Mr. Williams's opinion, will certainly receive within the next two or three years, as its share of profits of the Union Minière, about £400,000 to £500,000 per annum. As the Tanganyika company holds 40%, this second estimate, at £450,000 per annum, assumes that the Union Minière will make a profit of £1,125,000 per annum or £3,375,000 in three years. Obviously these figures are academic. Meanwhile, the debenture debt of £2,000,000 is a serious reality to the Tanganyika Concessions, and will require the production of a handsome output of copper by the Union Minière before it can be liquidated. We hope it will, and that soon, and that the enterprise as a whole may be carried to triumphant success, but we do ask that more technical information may be forthcoming.



SPECIAL CORRESPONDENCE

MELBOURNE.

Base Metals.—The fall in the price of metals will affect industry nowhere more than in Australia. Here gold mining is decaying, and men who formerly found employment at centres like Bendigo, Ballarat, Gympie, Charters Towers, or Croydon, have gravitated to the fields where the base metals, like copper, lead, or tin are won. Already the decline in the price of copper has brought home to the man who has sought investment in the copper region of North Queensland the dependence of the industry there on the markets of the world. He is a doubly disappointed man. First of all he was told by the buyer of his mine-products during the trade boom that culminated two years ago that there could be no relapse in the market for metals, that £70 per ton for copper was as assured as the presence of the tax-payer, also that there would be no difficulty in maintaining outputs to the high standard set by the Mount Elliott Company. But the price of copper has tumbled like a pack of cards before the breath of a trade depression, and yields have not held up to the point touched when machinery was new and conditions at their best. So with copper. With tin, matters are even worse. Instead of the price of the metal being a fixed £180 per ton, it now ranges at about £136 per ton, and the pious prayer of the 'streamer' is that some kindly influence will interpose to prevent a further collapse. One effect has been to cause the shutting-down of the Anchor tin mine in Tasmania. This property is owned by English investors, and it has been remarkable for the low cost at which it was worked. In all probability a record was established by the management in this respect, but that fact did not help it when tin fell. The grade of the ore is so low that, even with the aid of a Government grant, the claim could not pay wages. In alluvial mining the same thing is noticeable. Leases that could pay with tin at £200 per ton, or at £180 per ton, have to cry 'enough' when the figure is £140. Economic forces, therefore, are operating to

bring down supplies, and in all probability to restore in time the price of the metal to a higher plane. The collapse also has put an end to a good deal of the ballooning in connection with the Eastern tin-dredging flotations incubated of late, especially at Sydney. The public has gone off, and a return to more reasonable market prices is the result.

At Broken Hill there is not much that is fresh. The district is in a prosperous state, due to the fine price at which lead sticks, and the possibility of good profits being earned from the zinc side of mining enterprise, even with zinc at anywhere between £21 and £22 per ton. Public interest was immensely stimulated by the news that "a trust" had been formed in London to buy the shares of certain leading Broken Hill companies. The assertion that the mines were in such a state of industrial security that all the investor had to fear was the ordinary industrial risk of fluctuations in the metal-markets is very flattering to our vanity. Somehow Australians, who have a pretty keen nose for the good things of mining, do not seem inclined to swallow this optimism. There is no question as to the reserves in several of the mines, but when the dividends that can be paid with metals at certain prices are worked-out, it is felt that to buy when the market is so high as at present is to accept other risks than that of metals. At the moment a Royal Commission, appointed by the Government of New South Wales, is collecting evidence to inquire whether mining conditions at Broken Hill should not be improved. The Government is a Labour government; hence its sympathies must be with the worker, and the mine inspectors have already suggested certain so-called safeguards and reforms. But the direct object of the Commission is to investigate a proposal of the Unions in favour of the return of the district to the daily-wage system in lieu of contracting for mining work. Then, too, the steady influx of foreign labour is to be investigated. This is a far less serious matter than the so-called daily-wage reform of the

Unions. Under contract work for driving, stoping, mullocking, or wheeling, the best efficiency is obtainable. Under the daily-wage plan, payment by results disappears, and, as was proved prior to 1893, is followed by a very low efficiency on the part of the worker. The companies then decided once and for all to reject the daily-wage system. Now political forces are compelling the reconsideration of the subject, with a Government in power that is in absolute alliance with the Labour party, and is endorsing its planks. Moreover, the current agreement under the Federal Arbitration Court expires next year, and with profits flowing in such a stream from the Barrier it is hard to believe that the same court that has pushed up wages in every industry in Australia will excuse the rich corporations of Broken Hill when the workers want higher returns. So, added to the risk of the market for the metals, is that of a revision of the wage-list in favour of the worker. With lower metal prices everyone knows how a change of the kind cuts into available profits.

Oil.—There still exist enthusiasts who believe, contrary to geological conclusions, that oil-bearing strata exist along the southern coast of South Australia and at Kangaroo Island. A soul-stirring prospectus, issued to raise capital for boring purposes, has come before the Inter-State Commission, which deals with tariff matters and trade bonuses. The leading promoter admitted that he had to paint things with vivid colours in order to attract. Anyway, a certain amount of capital has been subscribed, and it looks as if some systematic work will be undertaken. It is a great pity that any enterprise of the kind is not associated with a detailed geological examination of new areas, so that in that respect at least science shall be made the handmaiden of man. More reliance appears to be placed on the deductions of Yankee oil-boring experts than on those of the field geologist. Still, surprises may ensue, and it is certain that the knowledge of the strata that will be obtained from the work now to be undertaken will be of high scientific interest.

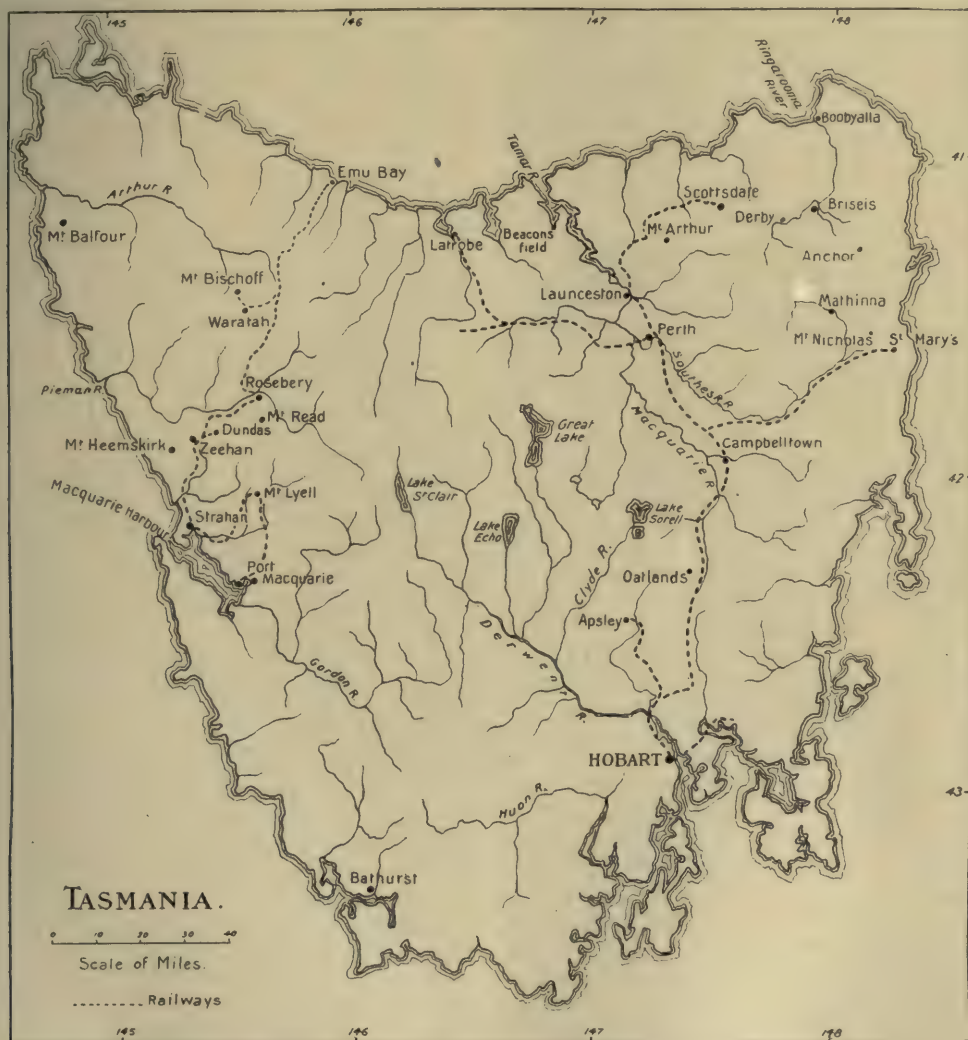
Chillagoe, in North Queensland, stands out so far as a failure. Those connected with the management have always been blessed with a happy optimism that would sit well on the leader of a forlorn hope. The company that took possession of the district started at the wrong end of the stick. Capital went into a railway and smelters before the mines were proved to be capable of supporting the smelt-

ing plant or of keeping the railway properly employed. Then it was believed that by extending the railway from the Chillagoe terminus to the Etheridge field there was a chance of a new source of ore-supply being developed. Now the company is taking a hand in opening up the Mount Mulligan coal-field, in the hope that it will provide cheap fuel and so reduce smelting costs. The Einasleigh mine is the only property so far, outside the Mungana group, that has lived at all up to promise. Now that the Mulligan railway is being completed, a bit more optimism is preached over the possibility of the flotation process being applied for concentrating purposes to some of the low-grade silicious material in the locality. This sounds very well, but the old question arises: whence is the capital to come to furnish the mines with the flotation plant? The annual meeting of the company, just held in Melbourne, saw some dreary figures presented. Expenditure goes on, and substantial profits do not materialize. At present the company hopes to sell its railways to the State government, and thereby help its British debenture-holders and the shareholders. The Ministry, however, appears to be somewhat coy, and may be presumed to put to itself the question whether it is wise to purchase when the district is doing badly, or whether it should hold its hand to see if a revival comes on the connecting of the Mulligan district with the mines. The inducement to buy is, of course, the possibility of retaining in the locality the existing mining population. If that disappears, the district may revert to the copper 'gougiers' or to the parties of prospectors, such as eked out a livelihood on the many little shows worked before the Chillagoe company settled down in the region. British capitalists own the bulk of the debentures, and a large wad of the shares of the company; they, therefore, have a close personal interest in the negotiations being carried on by the directors for the sale of their railway to the State, and in the endeavour of the management to apply the flotation process to the claims on the district.

Lucknow.—Steps are being taken to revive interest in the Brown's Creek mine, not far from the Wentworth Proprietary group at Lucknow, New South Wales. This property was once owned by a Paris concern, the *Compagnie des Mines d'Or*, and was under the management of W. A. Irwin, afterwards general manager of the Associated at Kalgoorlie. So far as records go, all that has been demonstrated is that a vast quantity of ore has been

won by open-cut and by shallow sinking, but it has never been proved that the ore has done more than pay wages to the worker. However, the mine has a good plant, and so it is to be tested again by Victorians. These know gold mining to the letter Z, and they will have no loading and no costly management. Perhaps under such control the newcomers may

Rosebery field to fuse interests there. Matters were delayed by an option given by the Tasmanian Copper Company to a group of European capitalists. The option has been turned down for the reason that ore reserves were less than was expected. How events will move now is not at all clear, though it is presumed that the London group, which has



SHOWING THE POSITION OF THE ANCHOR MINE AND THE ROSEBERY DISTRICT.

succeed where their predecessors failed, but as Euclid says, this has to be proved.

In Tasmania the Mount Lyell company has settled down into its old stride, and everything will be well if copper would only move up in price and if the eternal wage and labour questions were not likely to recur at an early date. So far no definite action has been taken by the parties most largely interested in the

been nibbling after the Hercules mine nearby, will seek to bring the Tasmanian copper mine within their embrace. As far as the Hercules goes, the point that has not been settled is as to whether Mr. Blakemore's writing-down of the ore reserves has been upset, as some contend, by the inspection of a director-expert, on whose words the London group is said to hang. Some vertical boring is said to have

added largely to the ore reserves of the mine, but better testimony would be furnished by trying to establish the width as well as the length of the shoot of ore. Nor has the last word been heard either at the Hercules or at the Tasmanian Copper as to treatment. The Metals Extraction Co., of London, is supposed to have spent £100,000 in plant to demonstrate the ability of the bisulphite process to treat the ores of the mine, but conclusive testimony on the point has not yet been produced here. Whether the company's contract with the Tasmanian Copper Company still exists, or whether it has been determined, is a matter for the lawyers to settle.

TORONTO.

Alberta Oil.—The interest in the oil discoveries near Calgary shows no signs of abatement. New companies are being organized, and many of those already in the field are preparing for active development. Over a dozen companies have closed contracts with the Janse Drilling Company for the sinking of wells, and the work is to be performed as rapidly as the equipment can be placed on the ground. The pioneer company, the Calgary Petroleum Products, the owner of the Dingman or 'discovery' well, has another well under way that is giving out a large volume of wet gas, and is arranging to put down a third. The management has had some difficulty in taking care of the flow of oil from the original well, and is hastening the installation of additional tank facilities. Experiments in the extraction of gasoline from the wet gas are stated to have proved satisfactorily the commercial feasibility of the process, and, should the gas output of the wells now being put down fulfil expectations, a condensing plant will be installed at a cost of \$50,000. The success of the extraction tests, which are stated to indicate a production of $1\frac{1}{2}$ gallons of gasoline per 1000 cubic ft., encourages the hope that large areas where the oil occurs at too great a depth for profitable production, with quantities of gas nearer the surface, can be rendered productive. A small quantity of oil has been struck in the well of the Southern Alberta, the analysis showing about 45° B., with a good showing of crude oil. A wireless telegraph service has been established between the oil-field and Calgary, with field-stations at the properties of some of the leading companies under charge of licensed Government operators. It is hoped that this will secure reliable information and prevent the circulation of false reports. Owing to the large

number of oil companies whose shares have been placed on the market, many of them have been unable to get their stock taken up, and find themselves without sufficient subscribed capital to proceed with development. Amalgamations are, therefore, in order as the best way out of the difficulty. The first merger is now being undertaken, including seven companies, the combined nominal capitalization of which amounts to \$22,500,000. The promoters of the project are C. A. Owens, W. D. Outman, W. S. Herron, W. H. McLaws, and other leading operators. The total holdings will comprise over 100,000 acres, and it is proposed to sink eight wells. The name and capitalization of the merger have not yet been determined. There is considerable speculation as to the intentions of the Canadian Pacific Railway in regard to its extensive holdings of oil-lands. Meanwhile it is overwhelmed with offers to lease many of these locations at high prices.

The Nakamun oil-field, near Edmonton, has begun to divide attention with Calgary. Extensive areas in that locality were leased some time ago, and operations were begun. An active movement in that direction was started early this month by the visit of Julius Fried, a noted California operator, who has taken up many claims in this district. His reputation as a successful operator caused a rush of local men to secure leases, and a large tract of land has been taken up. Mr. Fried has organized a company under the name of California Lakeview to operate in the Nakamun field. An anticlinal dome has been located, where the geological formation is favourable to drilling operations. A local company, the Nakamun Oil & Asphalt Co., has a well sunk to a depth of 1120 ft., and has encountered a heavy flow of gas and sand impregnated with oil.

Cobalt.—The prestige of the silver district has received several hard knocks lately. The phenomenal Temiskaming & Hudson Bay mine, which, having a very small capital and making operations pay from the grass-roots down, was enabled to declare 2400% dividends a few years ago, has been compelled to close-down owing to the depletion of its ore reserve. It has another Cobalt claim, which may perhaps develop as a producer, and holds a controlling interest in the Dome Lake of Porcupine. The La Rose Consolidated is apparently going the same way. Production has greatly fallen off, and official statements have been made to the effect that failing further discoveries operations will shortly be discon-

tinued and the accumulated surplus, which amounted to \$1,547,420 on July 1, divided among the shareholders. The Nipissing is in somewhat better shape, but recent development does not encourage the hope that its life will be prolonged by the discovery of good ore in depth. The estimated net production for June was \$183,558, as compared with \$211,256 in May. Vein 64, when cut at the 900-ft. level, where it was about 12 in. wide, showed only small silver contents. At this depth the vein was in the Keewatin, underlying the conglomerate, which in this portion of the district has been found unproductive. At the Cochrane a small shoot of high-grade ore, 3 to 5 in. wide, has been opened-up on the 100-ft. level. The same vein when cut on the 200-ft. level showed only low-grade ore. The Trethewey during the first half of the year produced 277,387 oz. of silver. The cash on hand and due from smelters was \$130,470. The Foster mine is being unwatered by the Foster Leasing Co. with a view to the resumption of operations. It is proposed to run a cross-cut from the 210-ft. level in the conglomerate below Glen lake. Development of the spur of the Big Pete vein of the Penn-Canadian on the fourth and fifth levels shows a couple of inches of rich ore. Good ore has also been encountered on the sixth level.

Porcupine.—The Dome, during June, milled 18,250 tons of ore, producing gold to the value of \$83,421, an average of \$4.51 per ton. This is the largest tonnage treated in any month since the company began publishing monthly statements. The yield per ton, however, compares unfavourably with the earlier months of the year, and it is evident that the question of dividends depends entirely on the ability to keep running expenses at a low figure. The regular 4-weekly statement of the Hollinger for the period ended June 17 shows gross profits of \$129,168 from the treatment of 13,898 tons of ore averaging \$14.59. The approximate extraction was 95.2%, and the working cost per ton milled \$4.57. At the Jupiter development has been active on the 400-ft. level, but assays are so variable that the value of the results can hardly be established without a mill-run. A winze is being sunk to the 500-ft. level. The Porcupine Lake has closed-down owing to lack of funds. An attempt will be made to re-organize the company. The McIntyre during June treated 4300 tons, averaging \$10.65 per ton. The net profit for the month is estimated at over \$25,000. A British syndicate headed by

G. G. von Polenz has acquired the South Thompson and the two Krist claims, having in all an area of 120 acres, and organized the Porcupine Krist-Thompson Mines, Ltd. The company is to be financed in London.

JOHANNESBURG.

Labour.—The 4th and 5th of July celebrations of the Labour party passed off pretty tamely, as those in the know had prophesied. A thinly attended meeting on Saturday was followed on the Sunday by a procession of some 10,000 persons carrying wreaths to the cemetery, where lay the victims of the frothy oratory of a year back. The orators being mostly away on summer vacation in the south of England, while a few were detained on parliamentary duty in Cape Town, the procession was readily controlled by seven foot-police following the band playing the 'Dead March in Saul.'

While the amalgamation of the several native-recruiting agencies afforded chairmen of companies more than a year's forecasting of future economies, some doubtful critics still exist, so much so that in the case of a certain company where there was a possibility of its leaving the wings of the Native Recruiting Corporation, this fact was reckoned as being a substantial source of economy to the company. Decreasing working costs have again lately loomed large in chairmen's speeches, and will no doubt continue to do so until some mining expert devises a new scheme of "profit per some funny thing or other," or until it is recognized that a mine, honestly worked, may not appear exceptionally well managed under either system, and yet may show the greatest amount of ultimate profit.

Timbering.—The supporting of excavations is receiving the most careful study by all thinking managers, especially when it is borne in mind that for the better part of thirty years it has been entirely neglected. At great depths and with comparatively small dips there is little use in attempting to support the roof of a bedded deposit. Carefully letting it down will prove far more satisfactory. This is best accomplished by copious 'pigsties,' preferably made of squared timber so as to save cost in packing, where labour is expensive. Unfortunately the price of suitable timber is rapidly going up, and the supply is none too large.

The General Mining and Finance Corporation, or Albu group, had a most unsatisfactory year, carrying forward a debit balance of £43,400 in spite of a credit balance of

nearly £6000 carried forward at the end of 1912. A revenue of £60,000, less an expenditure of £20,000, was not sufficient to meet a loss on ventures, outside the Rand, of £59,000 as well as certain other depreciation. It was comparatively recently that this group was reported to have cut down the salaries of the majority of its officials by 40%. However good economy that may appear to be, the results do not seem encouraging. Of its subsidiaries, the Van Ryn, with a profit of £20,000 per month, the Meyer and Charlton, with £20,000, and the New Goch, with £10,000, are the only mines of real importance.

The Goerz Group enjoyed anything but a good financial year, losing £14,663, in addition to £8789 written off in respect of claim holdings. Depreciation on shares and debentures amounted to about £500,000, while between the dates of making-up the books and holding the meeting an appreciation of £120,000 had occurred. Of the subsidiaries, the May Consolidated will probably cease operations at the end of the year, while the Princess Estate is little more than making ends meet with about £1500 per month profit. The Geduld Proprietary is doing somewhat better than the year before, with some £7000 per month profit, although, owing to labour shortage it has milled only 20,010 tons in May last with a plant capable of dealing with 24,000 tons and intended to be increased to 35,000 tons per month. Ore reserves amount to the substantial total of 1,757,000 tons of 6'9 dwt. stoping-value over 58 inches. Modderfontein Deep forms the redeeming feature in the group. It is estimated that this company will reach the producing stage by the end of the current year. At March 31 its ore reserves amounted to 1,173,000 tons, assaying 7'5 dwt. or 31s. 10d. per ton over a stoping-width of 73 inches. With such wide stoping-widths, a modern plant, and profitable ore occurring in large blocks, working costs are bound to be low and recovery good with a substantial profit per ton milled. The shares are having a run, and are standing at 60s. in mid-July.

The Robinson showed an almost all-round decline during its last financial year.

| | 1912. | 1913. |
|-----------------------------|-----------|-----------|
| Tons milled..... | 577,300 | 668,900 |
| Yield per ton..... | 43s. 8d. | 35s. 9d. |
| Cost per ton | 15s. 8d. | 14s. 1d. |
| Profit per ton | 28s. 0d. | 21s. 8d. |
| Total working profit | £808,761 | £724,792 |
| Dividend | 22½% | 15% |
| Balance unappropriated | £348,997 | £523,576 |
| Ore reserve tonnage | 1,130,600 | 538,500 |
| Assay value per ton | 11'0 dwt. | 10'5 dwt. |

Since its inception this company, with a capital of £2,750,000 and a mining area of 177 claims, has milled 7,308,875 tons yielding £18,500,000 worth of gold, allowing of paying £10,235,000 in dividends. But no mining claim has yet been discovered that will not in course of time become exhausted. The ore reserve has fallen considerably, and the day has arrived when boundary pillars are being drawn upon, their place in most cases being taken by sand-filling, which, though stopped from July to September, is now continuing apace. For a company in this position, amalgamation with a real live concern like the Crown Mines offers every advantage. "Better a poor settlement than a strong case taken to law" should be the maxim, rather than that preached by Mr. Hyman at the annual meeting. In refusing amalgamation, this gentleman advocates shareholders removing their noses so as to make their faces look plainer, but a few years hence may find poorer if not wiser shareholders and a crucified instead of an honoured prophet. The directors who sought to be re-elected and had resigned as a protest against the attitude of a certain section of the shareholders in refusing to ratify the action of the board were returned, while the representatives of the malcontents polled only 25,691 shares as against 99,767 in support of the board.

The Robinson Deep had a fairly successful year, all things considered.

| | 1912-13 | 1913-14 |
|----------------------------|-----------|-----------|
| Tons milled..... | 623,800 | 619,140 |
| Yield per ton | 29s. 6d. | 27s. 6d. |
| Cost per ton | 17s. 9d. | 17s. 0d. |
| Profit per ton | 11s. 9d. | 10s. 6d. |
| Total working profit | £379,090 | £324,725 |
| Dividend | 27½% | 27½% |
| Balance unappropriated.... | £118,342 | £105,408 |
| Ore reserve tonnage | 1,538,000 | 1,533,000 |
| Assay value per ton..... | 6'0 dwt. | 5'9 dwt. |

The company has been severely hampered by shortage of native labour. Up till the end of July 1913 the complement was 3966, while the average for the succeeding eight months was 3928. In spite of this, the working cost has been reduced by 9d. per ton milled, and the mine is being better worked today than probably ever in its history. In 1909 things looked pretty gloomy, and profits fell from £50,000 to £22,000 per month, and shares from 95s. to 65s. The company about this time fortunately secured from the Government the lease of a portion of adjoining water-rights and bewaarplaatsen. The high-grade ore extracted from this lease helped the mine considerably, but 1914 will probably see the last of this source of supply and the deep levels will

have to furnish the greater part of the output. The grade here is not wonderful, and it is no doubt with this in view that the shares stand round about 32s. 6d. The issued capital is £1,000,000, and the life, under normal working conditions, is estimated by Mr. Leslie, the somewhat optimistic superintending engineer to the company, at from 8 to 9 years.

Machine-drills.—Ever since 1909, when the Transvaal Stope-Drill Competition committee selected the Robinson Deep as one of the competing arenas, and especially since the publication of their costly, if unconvincing conclusions, the management has been busy testing the lighter makes of machines. At

bits with a Leyner, and the hand-steel with a Kimber sharpener.

Politics.—At the annual meeting some discussion ensued on the proposition for the re-election of Mr. F. D. P. Chaplin, M.L.A., as chairman of the Robinson Deep, some shareholders contending that his attention to politics took too much of his time, and that he should therefore resign his seat in Parliament, apparently on the principle that if "Drinking cock-tails interferes with business, why, chuck business." Mr. Chaplin not being present, the vice-chairman got the protests recorded, and the matter left over for this year, no doubt reasoning that the Union Parliament



REDUCTION PLANT OF THE NEW MODDERFONTEIN.

the present time 60% of their ore is broken by machines, and here the reciprocating drill is the favourite. With the hardness of rock encountered on the Witwatersrand, the dangerous character of its dust, and the employment of natives underground in stopes dipping comparatively flat, a system of underhand stoping is the general rule, and here the reciprocating drill holds its own. Without wishing to "mention names and get pack-drill," it is well-known that the small Holman is the general favourite in this mine. Although the smaller ball is found to wear rapidly, its replacement is an easy matter, and the cost is slight, while the air-consumption of the machine remains constant and low, and the cost of maintenance is small. All drill-sharpening is carried out mechanically: the machine-

elections take place within that time, and that if the chairman had not resigned his seat by then there would be a 5 to 1 chance of not having to ask him to do so.

CAMBORNE.

Carn Brea & Tincroft.—Of late we have had the amazing spectacle of the employees of this mine publicly criticizing its management, and of the directorate actually receiving a deputation from the men, before whom apparently the manager had to justify himself. It may be that the criticism of the men was justified, but what authority can the directors expect the manager will be able to exercise in the future after such procedure? E. S. King is no longer the manager of these mines, having been succeeded by his brother, A. Trevel-

yan King, and the chief cause of the trouble was the latter's attempt to reduce wages and the dismissal of men no longer needed, in his opinion. Then it was that the men decided to make representations to the directorate to the effect that it was only indifferent management that caused the mine to be worked at a loss, and that if other methods were adopted, the mine could be made to pay its way even on the present low price for tin. The memorial of the men ran thus:

"We, the undersigned, having been employed at North Tincroft for the long periods stated against our names, having heard that through shortage of capital the mine is likely either to be closed-down or handed over to South Crofty, beg to protest against either of the courses, and confidently state that the mine is better now than we have ever known it, and in spite of the low price of tin the grade is such as, with economical management, should even now pay, and when tin rises should make a grand profit. In our opinion, so far from being worked out, the mine is only now being opened up, and should shortly be one of the best mines of the district. We have been asked by the great body of miners employed to lay this before you."

Although no direct reply has been issued by the directors, yet it is freely stated that changes have already been made, which meet many of the objections made by the men.

There is no likelihood of the North Tincroft section being sold to South Crofty, although no doubt the latter company would be glad to take it over on reasonable terms.

The water difficulty, caused by the abandonment of the Carn Brea section, has been at last satisfactorily solved. Temporarily the 'lords' met the whole cost of keeping the pumping engine at work, but it was obvious that this arrangement could not be continued, and the owners of the neighbouring mines, which would presumably be affected by the stoppage, were invited to share the cost. The upshot was a conference between the 'lords' and representatives of the mines, Dolcoath, however, declining to confer or to join in any scheme. It was ultimately agreed that the 'lords' should provide the money (£7000) necessary to equip Harvey's Highburrow East shaft (at which a 90-in. Cornish pumping engine is installed) with a 20-in. pitwork to enable this engine to cope with the water previously dealt with at greater depths by four engines. The annual cost of pumping is estimated by Josiah Paull at £4355, and this outlay will be met jointly by the 'lords' and by

South Crofty and Carn Brea mines. East Pool is willing to pay £500 for a supply of water for use on its dressing floors.

Levant.—The scandalous treatment being meted out by one of the 'lords' to the shareholders in this mine in the matter of the renewal of the lease, which expires within the next twelve months, is causing grave concern in the Duchy, for, following as it does previous fines enforced on other companies under similar circumstances, it must of necessity disadvantageously affect the flow of much needed capital into the county. If companies are not to be able to rely on the renewal of leases on reasonable terms, then it is obvious that capitalists will not risk their money in such one-sided transactions, for it is not as though it was the general practice of the owners of mineral rights to either put up capital to assist in developing the properties or to spend anything on them when not under lease. It appears to be the policy of certain owners of mineral rights to exact heavy dues on the produce, even although the mines may be working at a loss, and then when the lease has to be renewed, to demand conditions that heavily penalize the shareholders to the advantage of the 'lords,' or force them to abandon the property at a considerable loss. Such tactics are sheer robbery, and the surprise to me in the case of Levant has been the moderation of the principal shareholders (Messrs. Bolitho and Oats) in voicing their views. In this mine, one of the 'lords' has formulated obviously unreasonable terms for the renewal of the lease and is not apparently even prepared to discuss the matter with the directors. The shareholders have therefore decided to pick out the eyes of the mine within the next few months and then abandon the property if no better terms are forthcoming. A loss of £2540 was made on the last account, so even if all development is stopped and the poorer stopes abandoned, it will be no easy task to make ends meet with the present price of tin.

Closing of Mines.—The continued depression in the tin market has dashed any hopes that there may have been of getting further capital for the Condurrow mine, so it has been decided to stop the pumps, and the machinery will be sold early next week. Operations at the Phoenix mine have also been stopped. The forecasts in this magazine, that the capital provided, when Bewick, Moreing & Co. took over the management, and again recently when £15,000 was provided on debentures by the Duchy and others, would be insufficient, have proved accurate. It is un-

derstood that the Duchy authorities were prepared to provide further capital, but the shareholders were unwilling to join. All work at Killifreth, North Dolcoath, and Prince of Wales mines has been suspended. As regards the former, when the company was formed, it was stated that £40,000 working capital had actually been subscribed, but apparently some of the subscribers cannot meet their obligations, for otherwise there would be no need to close-down the mine.

Dolcoath.—Malcolm Maclaren has been engaged to make a geological inspection and report on the mine, and it is rumoured that he is already convinced that money spent on lateral development is likely to be more profitable than development on the main lode in depth. F. W. Thomas has resigned the secretaryship of the company to take a position with Williams, Harvey & Co. at Liverpool. Is this in intelligent anticipation of the future?

NEW YORK.

Copper.—The decline in the Lake Superior output of copper last year to 136,000,000 lb. (the smallest year's production since 1895) naturally gives rise to speculation as to whether the Lake will not gradually sink from prominence in the American copper-producing arena. So recently as 1886 the Lake district produced 51% of the total copper of the United States; last year it only yielded 12% of the whole. This relative decline, however, is due to the increase of the other districts, notably Arizona and Montana, for the Lake output year before last was three times the output in 1886, which represented one half the total production of this country for that year. Compared only with itself the Lake district has shown steady progress and the tonnage now being milled is greater than at any previous time. However, those who wish to take a pessimistic view-point in regard to the Lake mines can find plenty of ground to stand upon. The larger mines have penetrated to considerable depths, as much as 8000 ft. on the dip, and the difficulties of working at so great a depth below the surface are too obvious to need mention. A further difficulty is that the support of the hanging wall becomes more of a problem with increase in depth, and it is becoming more and more evident that the workings will have to be filled. Filling is expensive; the mere transport and distribution of filling material at a distance of nearly two miles below the shaft-house involves a high cost, while the securing of this material is a problem in itself. F. W. Denton

has begun to use stamp-mill sand for this purpose, but even this material involves a good deal of expense. In order to keep down mining costs at these great depths the breaking and hoisting of ore must be done on a large scale. This involves the handling of lower-grade ore, for in most of the lodes only a part, usually the upper, contains much copper and toward the foot-wall it becomes too low-grade to yield a profit. By mining and milling on a large scale, operating costs can be lowered to such a figure that this material can be profitably treated, yielding a considerable additional amount of copper. This line of progress is shown by the Isle Royale, now controlled by the Calumet & Hecla, which is being developed on a large scale, yielding ore that averages 14 lb. copper. This compares with the 30 lb. per ton now being obtained from the Calumet & Hecla conglomerate lode, and 20 lb. per ton from many of the other mines, the latter content being the present general working basis.

No less important than decreasing the working cost is the increasing of recovery. Even in good recent work the tailing carries 5 lb. copper per ton, while the old tailing was oftener richer than some present-day ore. Through the initiative of C. H. Benedict, mill metallurgist for the Calumet & Hecla, the practice of re-grinding the sand tailing in Hardinge mills and concentrating on tables has developed. Even this tailing contains an appreciable amount of copper and Mr. Benedict has devised a leaching process involving the use of the ammonium carbonate-oxygen reaction, which is expected to recover 75% of this copper at a cost of not over 35 c. per ton. Where the net recovery is 10 lb. copper per ton, there is just as much profit in treating material containing 12 lb. per ton, leaving 2 lb. in the tailing, as there was in the older practice of treating material containing 20 lb. per ton, leaving 10 lb. in the tailing. There are immense areas in the Lake Superior district that may contain workable deposits, but which have never been adequately prospected, while the present known reserves of lower-grade ore will suffice for many years to come. It appears, therefore, as though the proper view-point regarding the Lake district is one of optimism rather than pessimism, so far as output is concerned. The copper mining industry there will long be the basis of thriving communities, though it goes without saying that dividends are likely to shrink to the modest figures that railroads and other well established industries usually pay.

PERSONAL.

C. O. BANNISTER, lately professor of metallurgy in the Sir John Cass Institute, has joined the firm of Edward Riley & Harbord.

H. BERTRAM BATEMAN is returning from Portuguese East Africa.

H. T. BRETT has accepted the managership of the Falcon mine, at Umvuma, Rhodesia.

R. W. BROCK, Deputy Minister for Mines, is returning to Canada on the *Virginian*.

E. W. BYRDE has gone to Turkey.

J. MORROW CAMPBELL is home from Nigeria.

E. J. CARLYLE, recently at Anaconda, has returned to London.

J. W. CARROLL has been appointed manager of the Mount Lyell Blocks Copper mine.

H. H. CLAUDET has gone to Norway.

GEORGE E. COLLINS sailed for New York on July 29, on his return to Denver.

A. J. DE BAVAY is here from Melbourne.

E. C. DURDEN has obtained an appointment at the Ottawa branch of the Royal Mint.

C. M. EUAN-SMITH is here from Burma.

ROWLAND FEILDING is a captain in the City of London Yeomanry (the Rough Riders) and has volunteered for war with his entire company. He saw service in the Matabele war.

M. E. FRENCH-WILLIAMS is examining mines in France for a Paris syndicate.

ALEXANDER FYFE left on July 29 for Venezuela.

HENRY J. GIFFORD, superintendent of the Champion Reef gold mine, has returned to India, after a holiday in England.

R. H. GOODWIN, manager of the Karabournou mercury mine, is home from Turkey.

J. A. L. HENDERSON returned recently from Canada.

W. A. HEYWOOD has returned from the South American Copper Syndicate's smelting plant, at Aroa, in Venezuela.

GUILDFORD HOSKINS, of the Lithgow iron-works, New South Wales, is visiting the United States and England, with a view of studying the most recent blast-furnace practice.

THEODORE J. HOOVER is in California.

HENNEN JENNINGS is at San Francisco.

T. J. JONES has arrived in London from Kyshtim, Siberia.

C. B. KINGSTON is on his way to Rhodesia.

A. E. KITSON, director of the Geological Survey of the Gold Coast, is now in England.

H. H. KNOX was in London, expecting to go to the Altai.

H. B. MAUFE, Director of the Rhodesian Geological Survey, is in London, but expects to return shortly.

SAMUEL MAYNE has been appointed manager of the Rupee mine, near Broken Hill.

E. T. MCCARTHY and EDWARD HOOPER are reported as returning from Canada on the *Virginian*, due on August 12.

W. W. MEIN and RALPH STOKES were recently at Caribou, in the Yukon territory.

T. E. MITCHELL, for many years identified with the mining of large orebodies in Butte, passed through London on his way to take charge of the underground work of the Burma Corporation.

HORACE G. NICHOLS left London for Burma on July 30.

R. FRANK PEARCE is metallurgist with Laws, Rumbold & Co.

H. M. RIDGE is reported to be detained in Germany.

H. P. ROBERTSON was in Paris, on his way to a new post in Spain, on August 4. He had to return, with difficulty.

HUGH ROSE, manager of the Santa Gertrudis, has arrived from Mexico.

W. E. SIMPSON expects to return to Mexico shortly.

CHARLES A. SMITH is superintending the construction of the new plant for the Société des Mines de Malabau, at Malabau, France.

O. J. STEINHART has returned safely from Bohemia.

GEORGE E. STEPHENSON has returned from New Zealand and Australia.

B. B. THAYER has been making his semi-annual inspection of the Amalgamated properties at Butte.

H. L. SMYTH is to be head of the combined mining school of Harvard University and the Massachusetts Institute of Technology.

ROBERT STICHT was recently a visitor at Anaconda and afterward went to Denver, where he gave an address before the Colorado Scientific Society.

D'ARCY WEATHERBE expects to proceed at an early date to Cobalt, Ontario.

H. C. WOOLMER, of the Spassky mine, is here from Moscow.

H. G. YOUNG, recently manager of the Trethewey mine at Cobalt, has become consulting engineer to the Algonican Development Co. at Juneau, Alaska.



DISCUSSION

Wolframite Industry of Lower Burma.

The Editor:

Sir—Having spent the years 1913 and 1914 in the Tavoy district, I was much interested in Mr. H. D. Griffiths' article on the above subject appearing in your June number.

I should like, if I may, to offer a few remarks, not in any carping or controversial spirit, but because in one or two cases Mr. Griffiths has evidently been misinformed. Some of his statements give me the impression that he has generalized perhaps from information got on the particular properties that, I understand, he visited in the course of his stay in the country.

Mr. Griffiths begins his article in flippant vein at the expense of the Government and the powers that be, and no one who has been in Tavoy long can wonder at a visitor's surprise at the way the Government treats the district; but it is only fair to say that there are evidences of a wakening interest in the needs of Tavoy, and that the authorities have always been only too anxious to get suggestions and advice from responsible people to assist them in dealing with what is to the local Government an entirely new problem and condition of affairs. The boom in Tavoy only started comparatively recently, and that there was no proper survey of this hitherto unknown and unwanted land, and no machinery in the departmental offices to deal with the enormous increase of work consequent upon the rush for claims, was no fault of the Government; and although I have suffered as much as anyone, having been for the first two years general superintendent of all the Tavoy group, one has to realize and own that though perhaps slow as a whole, every individual officer with whom we have had to deal has done his utmost to grasp the situation and afford every assistance as far as lay in his power.

Referring to the antiquated paddle-boat, the famous *Envoy*, which took us to and from Tavoy and the mouth of the river where the big boat anchored, Mr. Griffiths is pleased to be facetious when he speaks of "at least six

inches" of freeboard. In any case this would not have mattered, as she never had to encounter weather, and now she has been replaced by a much larger steamer; not before it was time, it is true, but Mr. Griffiths must have been unfortunate in his trips up and down if he experienced such difficulties with sand-banks catching him until next tide, as I have known the Tavoy river intimately for over two years and although such cases are known they are very rare. And he is mistaken as to the facilities for landing machinery and heavy goods. These are not good, but are not as bad as he paints them, and things have not got to be "rolled" up mud-banks ashore, for the British India company has a goods jetty where the cargo-boats (sailing junks) unload; and as there is a large dredge working tin alluvium, and other machinery, in the district, the lightest parts of which go into tons, the means of landing, though primitive, must be fairly effective. More serious than the landing difficulties hitherto have been the dangers of the road, where the bridges were for the most part quite inadequate, but these are now all replaced by modern structures or are in the course of reconstruction.

Bears, panthers, and tigers are mentioned in the same category as watercourses and leeches as being "abundant." This sounds very terrifying! But if the lesser carnivora, mosquitoes and sandflies, be substituted for the fiercer animals, I am prepared to subscribe to the statement of abundance. As a matter of fact, coming from India, one is struck by the apparent absence of animal life in the jungle. Mr. Griffiths is quite right as to the presence of them, but one hardly ever sees them, owing chiefly to the dense undergrowth.

I was disappointed with the map of the district published with Mr. Griffiths' article. Although only purporting to be a sketch map, I am sure one of the companies could have supplied a much more accurate and recent one, though so far as I know, no official map has yet been issued by the Government.

The remarks as to the mining regulations

are sound and to the point, but here again one must remember that official views are still 'fluid' in regard to these matters, and the present rules are avowedly only a first attempt to crystallize them. All local companies and bodies were asked long ago to co-operate in the framing of these rules by suggestions, and in this matter the newly formed Chamber of Mines should be able to give valuable assistance, if it is a going concern. It was formed last year, and at the time of my leaving the district I had the somewhat doubtful honour of being its President. Much controversy had arisen as to its composition, but some such body, composed of representative men, is necessary in any new mineral region.

Mr. Griffiths opines that there is "not a single pestle and mortar in the district," but here he is at fault, as any number have been given out in some places, and discarded. Neither John Chinaman, Jack Burman, nor Ramasawmy like them, and as practically all the work is petty tribute, they get their own way. Also it is true that where no mechanical savers or tables are in use and all the washing is by hand-panning, the loss in fine stuff would be greater even than it is if more of the ore were pulverized. Until the companies operating here work upon proper lines, and do away with hand-washing, enormous losses will continue.

When Mr. Griffiths speaks of cassiterite having been for some time thrown away as an impurity, because the workman was "only paid on the assay-value of wolfram," he is obviously referring to a particular case, as also when he speaks of "single" gunny bags being used in the packing of ore for export, for double bags have been almost universal, though not really necessary. The shipping companies at one time insisted upon them, as a Bibby liner arrived home with a single-bagged consignment lying about as loose ore in the hold, the bags having been entirely demolished by their content of damp fine ore. And, again, when giving the rate for contract work prevailing in the district as being so much per foot plus Rs. 250 per ton, Mr. Griffiths refers to the system established by the group with which he was connected, for these rates are not the rule, nor does any other company that I know work on that rate. Rates vary enormously, and together with the labour question generally, are, as Mr. Griffiths rightly points out, a matter upon which the Chamber of Mines should bestir itself.

Chinese and Burmans are the principal workers engaged in winning ore. The Southern

Indians or Tamils are in a very small proportion. As a matter of fact, there are more Telugus than Tamils in the district, but Indian labour is used for such work as road-making, rather than for getting wolfram. A few Ghurkas and Pathans are similarly employed.

I trust that Mr. Griffiths will not take amiss the criticisms suggested by a perusal of his article. There is as yet so little literature from this district that his article is a valuable one, and he must not mind my few corrections and remarks upon more or less unimportant points. I have severely left alone the geological and possibly contentious aspect, where again Mr. Griffiths' views are interesting and valuable. The only publication of any importance hitherto, as far as I am aware, is Bleek's monograph in the Records of the Geological Survey of India (Vol. XLIII, Part I, 1913), and we have to learn much more yet about the district before definite conclusions can be reached. It is a district of considerable promise.

C. BEADON.

London, July 12.

Short Tube-Mills.

The Editor:

Sir—Mr. J. C. Farrant, in replying to my questions in the May issue of the Magazine, states that "the San Poil Cons. Co., of Washington, installed an 8-ft. by 7-ft. short tube-mill, but after operating it for a short period the management reduced the diameter to 6 ft. by re-lining the interior, owing to the excessive horse-power absorbed."

The question with which we are mainly concerned is power consumed per ton of material ground, or tons reduced through, say, 40-mesh per horse-power-day. It looks as though the San Poil 8 by 7-ft. tube was under-fed, consequently the power absorbed was excessive. Actual figures and results of these tests would be interesting.

He states also that the Federal Mining and Smelting Co., of Idaho, installed a 7 by 12-ft. tube-mill in 1913 to compete with the Hardinge mill. This mill was converted into a conical one by bolting heavy timbers inside, forming two cones. The converted mill effected a saving of 14% in power and gave a more desirable concentrating product, according to Mr. Farrant's letter.

A 7-ft. by 12-ft. long mill cannot be classed as a short tube-mill, to which our discussion is confined. Such a mill would produce a considerable quantity of slime and would not be suitable for a concentrating mill. This

result would be similar to competitive tests between an 8-ft. by 30-in. conical mill and a long tube-mill for all-sliming purposes. I venture to say that if the above 7 by 12-ft. mill had been cut to 7 by 7, it would have effected a saving of more than 14%, besides producing a product suitable for concentration. When we compare short mills with conical ones, we should consider those with lengths not exceeding their diameters, for example, short tubes of 7 by 7, 8 by 8, and possibly 10 by 10.

Recently at the Butte & Superior Copper Co's. plant at Butte, Montana, competitive tests have been made between short and conical mills. Short tubes here have proved more efficient, and on the strength of these results more are being added. This is only a start, for many engineers now realize the possibilities of the tube-mill—short tubes for fine grinding with a minimum of slime suitable for concentration plants, and long tubes for partial or all-sliming, depending largely on the length of mill.

A. E. DRUCKER.

London, July 14.

Modern Ocean Travel.

The Editor :

Sir—One is apt to wonder at times if the mining engineer of today does not look back with regret to the days when the best state-rooms went to those who booked earliest, and not to those who paid exorbitant fares, and when ocean travel at first-class rates meant only about 30s. per day, whether one went to China, India, South Africa, or Australia. True, with the increase in fares there has been an increase in comfort, so that even Lord Randolph Churchill might find it difficult to complain of the cuisine on an up-to-date liner. Indeed, it is a fact that on the latest Hamburg-American liner the menu in the ordinary dining-saloon compares quite favourably with that of the special Ritz-Carlton restaurant on board.

One is apt, however, to regret the tendency to place the main dining-saloon on a lower deck and to reserve the upper decks for the special pay-as-you-go Ritz-Carlton; but it is only fair to mention that ventilation has so improved and the height of the decks above water has so increased that one does not notice the lower placing of the main saloon. I cannot even remember whether the central dome of the huge dining-saloon of the *Vaterland* is during day time illuminated by artificial light or not. This must be considered a tribute to the lighting arrangement.

The tendency of ten or fifteen years ago to

introduce small cabins for one occupant only never appeared to me to attract the ordinary traveller, who has a horror of a small sleeping apartment; and nowadays one observes in the latest liners single-berth compartments as roomy as the double or four-berth compartments of a few years ago. As for luxuries, these are almost incredible when one remembers, as I do, the old system of lighting cabins by a triangular space holding a candle or lamp designed to serve for two adjacent cabins and the gangway. Even when electricity came into use, it was hampered by regulations compelling all lights to be switched out, even in cabins, by ten o'clock. On some lines quartermasters were even sent to the various cabins to see that these instructions were carried out; but these were lines that appeared to be run on the mistaken idea that the public should be made to feel it a privilege to be permitted to travel in their steamers. A little healthy competition has been effective in disposing of this idea, at any rate so far as Australia and South Africa are concerned; but it dies hard, and I am not sure if it would not be to our advantage to inculcate into the minds of the boards of steamship companies that it is an honour of quite a lucrative nature to cater for the transport of accredited members of the mining engineering profession. Be this as it may—and I shall refer to this later—I repeat that the luxuries obtainable today are well nigh incredible. Gone, it is true, is the one cow in whose short and uncertain life we used to take so friendly an interest, and whose natural product evaporated mysteriously before it reached the saloon portals; but the milk one obtains is quite serviceable, and fresh food, vegetables, and fruit are in plenteous variety. On a recent trip we had a large-sized swimming bath, with a depth of eight feet of sea-water always maintained at about 72 degrees. There was also a gymnasium, and a ball-room whose parquet floor, columned walls, and domed roof challenged comparison with those of many a palace.

But all this luxury has to be paid for, and one can be forgiven if at times one looks back with no little regret to the smaller ship, with its social developments and its low passenger rates, now that one is faced with the fare of £5 to £8 per day, or even more, demanded by a modern American liner.

One of the most enjoyable voyages I have had of recent years was on the *Laurentic*, a fine triple-screw steamer plying from Liverpool to Quebec and Montreal. I may be mis-

taken, but I was under the impression that I arrived at Quebec within 12 hours of the time I should have done had I travelled by the *Lusitania*, leaving Liverpool on the same day. On the *Laurentic*, for a rate of less than £3 per day, I had the sole use of a capacious, comfortably fitted, outside cabin, and among the passengers were to be found the Dominion Minister for Railways, the chairman of the Grand Trunk Railway, and the chief mining man of the particular province to which I was going. Instead of life on board resembling that of a huge hotel, with the resulting isolation of each unit, we were a series of affably-disposed groups, extending to each other the courtesies of life. From the point of view of a mining engineer travelling on a visit of inspection, the environment could scarcely have been more congenial or more useful, and one is apt to find this to result almost invariably from the selection of a slower boat rather than that of the fastest crack steamer of the day.

I refer above to the idea of a combination of mining engineers. This might be of no little benefit to the profession. One finds special privileges extended to the stars of the opera, to ranchers, and the like. We travel probably more than any other profession. The matter of rates and of comfortable accommodation is of great importance to us, and I am of opinion that by combination it should be possible to achieve an understanding with the various lines concerned whereby any accredited member of the Institution should receive outside cabin accommodation at the minimum rate. Excess rates amount to a heavy tax on those of us who are continually travelling, and in view of the frequency of our voyages we ought not to be called on to pay them. I feel certain that if some competent body would take this matter up, organize and handle it, the result would be of great benefit to us. We could possibly arrange for the American Institute to join us in the arrangement and also the various colonial Institutions whose presidents are represented on our council. This is a matter that *The Mining Magazine* might well take up and I commend it to your attention.

ALFRED JAMES.

London, July 17.

[This is an interesting and suggestive letter. The idea of getting a 'favoured nation' treatment for mining engineers ought to be practicable, and we shall take steps to ascertain what can be done. We refer to the matter elsewhere.—EDITOR.]

Reliability of Reports.

The Editor :

Sir—Allow me to pen a few remarks on the discussion that you invite on the above subject. I do not happen to know anything concerning the Juga property, or the company interested in its exploitation; but I am loth to allow the slur cast on the mining profession, especially associates of the Institution of Mining and Metallurgy, to pass unchallenged. Regarding the point at issue, there is much similarity of criticism to that usually levelled at the medical profession, when affairs have not run smoothly, or when results have been disappointing. In either case it is the professional man who has to bear the blame, although he may not be entirely responsible. The medical man gets blamed, if the patient dies through careless nursing, or if his instructions have not been obeyed by the patient.

In any profession or walk of life no man is infallible. We learn by our mistakes. No doctor can diagnose a difficult case all at once; still, he attempts to make the patient well. Similarly, it is as difficult for a reporting engineer to give always a true verdict on a prospect or on a new country. Just as the very sick man goes to a specialist on his disease, so should a mining company seek the advice of an experienced engineer when in difficulties. It seems absurd to expect men of ripe age and experience to run risks attendant on travelling in countries with a bad climate, and undergo the discomforts incidental to travelling to god-forsaken spots for a fee however large; as the consulting engineer would have to leave his business in the hands of the junior members of his staff, and may lose retainers far more remunerative than the report on which he was engaged. If financiers and promoting houses require reports on which they can rely, let them go to the older members of the profession and ask them to select a young engineer. The younger man is then responsible to the consultant, and has his advice and help in any difficulties that may crop up, while the consultant will always have the last word in the editing of the report, and will give the report a distinct value by signing his name to it before presenting it to his clients.

Reports may be extremely favourable with conservative estimates, yet the undertaking may even then be a failure through overcapitalization or bad management. It is quite evident that the shareholders and directors cannot blame the reporting engineer should failure be attributed to subsequent mismanagement, unless the reporting engineers

are responsible for the scheme of finance and management.

The history of many a mining company goes to prove that discrepancies between original estimates of profit and final working results are not uncommon, especially those relating to alluvial propositions. It is a curious fact that in the case of the Juga company there are apparently three distinct reports, by three engineers, who all seem agreed on the estimated recovery of black tin. Is it possible that these engineers could have compared their estimates and agreed to a definite figure? Supposing the estimated recovery was arrived at by the engineers working independently of each other, the only conclusion is that the work was well done or that the ground was scientifically salted.

If the estimates were different, why were they not made public?

If the quantities were identical, why could not the management obtain results approximating the estimates?

Did the management suspect illegal dealings or take any steps to verify estimates when returns were not up to expectations?

During the boom of the Southern Cross district in Western Australia a certain mine manager was smart enough to discover that his company's property was not all that it was reported to be, and took immediate steps to inform his board of directors. The news eventually became public property, and the manager got slanged for not knowing his work, and for speaking the bitter truth. In other words, the truth was out before those financially interested had time to unload their scrip. Time has shown that this district was not all that it was reported to be.

Some financiers and mine-owners, although the first to blame the reporting engineer, are also the first to avoid payment of fees, if the report reads unfavourable, or the property is condemned. It is to be regretted that more steps were not taken to investigate the charges brought against the reporting engineers, whom you mention by name, before publication of this sordid business.

The trained mining engineers, in whatever capacity, but more especially associates of the Institution, are endeavouring to emulate the example set by the older members. The majority would welcome an impartial inquiry into the matter, as the slur cast by the two articles on the associates generally is not justified until an inquiry has been held. We are proud to belong to an Institution that sets up a high professional code for its members,

and which as a body is endeavouring to teach the public that a mine is not only a hole in the ground into which they can cast their surplus cash.

There is one small consolation in the first article, which reiterates those published in the issue of September 1913 (on page 169), and that is the question of remuneration. Unless a man gets paid proportionately to the value of the work expected from him, it is illogical to expect him to be satisfied with his billet, or to worry much as to what happens to the property. To expect trained men to go to unhealthy climates for small salaries after having gone through a long course of study and apprenticeship in school and mine is the quickest way to stop the supply of engineers to take the place of those who have gone before.

The only conclusion I can come to regarding the Juga property is that the blame does not rest entirely with the reporting engineers, and that some explanation is necessary.

ERIC J. STAREY.

Nairobi, June 14.

[Elsewhere in this issue we refer to some of the matters discussed by our correspondent. —EDITOR.]

Tin-Dredging in Burma.

The Editor:

Sir—Looking backward only a very few years to the time when all the tin mines were in the hands of Chinese, the change has been rapid; today British companies capitalized to over £800,000 are successfully operating and constructing 15 dredges of the largest capacity and most modern type. In the comparatively short distance along the coast line from Renong to Tonka in the Renong valley, there are six of the most up-to-date tin dredging-machines driving deep into the alluvium day and night, bringing to the surface large quantities of cassiterite that could not be won profitably by any other known method. In the same valley, but a little north from Renong, two dredges are being constructed; and again south from the town of Renong, at a place known as Ratroot, one dredge costing £36,000 is being built. At Tonka, still farther south, seven of them are paying handsome dividends to their respective shareholders.

Looking forward, one can scarcely conceive the extent and value of properties that may be added to those already developed. Over extensive alluvial deposits in southeastern Burma, and along the flats tributary to the

Pakchan river in Siam, there are ample inducements to legitimate exploration, by competent and sober-minded engineers, backed, of course, by ample capital to prospect by hand-boring, which has proved to be accurate enough for all practical purposes. Following on lines adopted by the companies already operating here successfully, of prospecting carefully, one feels safe in saying that the outlook for further expansion is splendid. Labour is plentiful, transport is good.

A. B. SNOW.

Victoria Point, Burma, July 5.

Cobalt.

The Editor:

Sir—Referring to your leader on Cobalt in the July issue, I take the greatest pleasure in endorsing your eulogistic remarks concerning the invaluable work done by Mr. Willet G. Miller in the mining districts of Ontario. I should like to point out that my official report, to which you refer, was not written for publication, but I specially wish to acknowledge the great help that the maps and sections prepared by Mr. Miller and his assistants have always been to me in my work in that region. I had occasion to use data from Mr. Miller's first report on Cobalt as long ago as 1906, and in my opinion his geological views, as expressed at an early date, have been more firmly proved as time and the fuller exploitation of the district have advanced.

D'ARCY WEATHERBE.

London, July 20.

Ore.

The Editor:

Sir—If the interesting discussion on the definition of the term 'Ore' is not closed, perhaps you will be good enough to publish this little expression of opinion from the Antipodes.

It would really appear that upon only two points are the various disputants agreed, namely, that 'ore' is a rock that contains something of value, and that the adoption of some precise definition is 'a consummation devoutly to be wished.'

Now, Sir, apparently there are two interested parties, each of whom has a different meaning when using this same word. The scientist employs it to describe a mineral that contains useful metal, while the technical man in his professional wanderings from Dan to Beersheba gives it as a name to any rock which he can mine and from which he can extract the useful portions with (or without) a

profit in the doing. And among the technical men there is no consensus of opinion, since some hold that the word should embrace all minerals of value, some contend it should be confined to describing the metalliferous rocks, while yet others are found who assert that those who do not stipulate for the profitable handling of the material are altogether in the wrong. What is sauce for the goose may be sauce for the gander, but, *certes*, one man's 'ore' is another man's 'waste.'

Webster defines 'define' as "to determine the precise signification of" a word. Can there be any precision when the suggested definition is obscured and blurred with provisos and restrictions dependent for their operation on fickle fortune and the spasmodic activities of man? A definition that shall be fundamental, explicit, and of lasting truth must surely embrace only those properties which are common to every member of the subject under definition. Hence if we postulate that 'ore' is a rock that contains metal of value we find that the above conditions are complied with. The boundaries of the meaning of the word are defined, wide though they be, and it would seem impossible to narrow them down without doing violence in some quarter. For, broadly speaking, all metalliferous rocks must be looked upon as possessing potential value, since with the progress of science those now held to be worthless may anon prove of economic value. To attempt to limit the use of the word to those rocks alone which under favourable local conditions man can now work at a profit is surely to court confusion in camp and council. The word cannot have a general qualitative meaning and at the same time a local quantitative significance; it would be as easy to fit all humanity with one size of shoe.

Would it not, therefore, be as well to agree that 'ore' should be broadly defined as 'metalliferous rock,' and permit mining men, when the generic term fails, as it must in describing specific examples, to qualify the noun suitably? There are adjectives in plenty in the language expressly made for the more perfect understanding of indefinite nouns, and by a judicious use thereof the mining engineer need surely have no fear but that from the context and the qualification of such words as 'ore,' whether in the written or the spoken word, he will be able to avoid ambiguity. For, to be lucid and explicit are greater virtues for him than to excel in scientific phraseology, and a report to non-technical directors and shareholders is of more frequent occur-

rence than an address to a scientific congress.

G. W. EATON TURNER.

Wellington, New Zealand, June 5.

[This voice from the other side of the world is entitled to be heard. We agree with our contributor on many points, but not with the final result of his research. Truly, to define is to determine the precise signification of a word, but his own definitions do not stand the test. What is meant by saying metal "of value"? The gentleman does not define. If 'ore' is "metalliferous rock," the poorest dump is 'ore,' and the leanest discard in the stopes of a worthless mine is 'ore.' We are trying to separate what should be the object of mining operations from what should be avoided as a cause of economic loss. "Ore is rock from which metal can be extracted to economic advantage." A definition must be brief, not only for convenience, but to avoid the use of words themselves needing to be defined.—EDITOR.]

Institution of Mining and Metallurgy.

The Editor :

Sir—In November 1913 I received a list of the subscribers to the 21st Anniversary Fund of the Institution. Great was my surprise on reading through the list of donors, to note the absence of the names of many members and associates of my acquaintance. This was all the more astonishing as nearly all these gentlemen are earning salaries of from £350 to £800 per annum, and, such being the case, they could surely easily afford a subscription to such a good cause. After due consideration, it struck me that perhaps these gentlemen had not then received the notices sent out by the Secretary asking for subscriptions, or perhaps they had received them and were then considering what amount they would donate.

Last month, June, I received a further list of subscribers up to May 28, 1914. On searching through the lists I was astounded to notice that these gentlemen had not even then made a subscription. Although myself only the donor of a very small sum (a sum commensurate with my circumstances at the time) I must confess that the fact of these gentlemen turning a deaf ear to the appeal, so ably made by our recent President, Mr. Bedford McNeill, is truly surprising. I have heard some of the non-subscribers I have in mind talking much about the benefits that the Institution conferred and the honour of belonging to it. If they really think so much

of the Institution and of their profession, I cannot think why they are unable to afford even a small donation to the fund, as a mark of their appreciation of what the Institution does and has done for them.

I understand that about £3000 is still needed to clear off all advances, etc., from the bank. I am sure it is the earnest wish of all that this sum may be speedily assured and that all who have not already done so will send in their cheques at once. Today I have sent a further small donation to the fund, and a newly joined Associate, a friend of mine, has also sent a donation. I hope all those gentlemen who are able to do so will pull out their cheque-books and without delay send something toward the 21st Anniversary Fund, remembering the words of Lord Bacon, as quoted by Mr. Bedford McNeill when making his appeal: "Every man is a debtor to his profession."

J. H. FORAN.

Loeboe Sikaping, Sumatra, July 1.

Tube-Mills v. Conical Mills.

The Editor :

Sir—In your June issue, in answer to the question of Mr. A. E. Drucker: "Is there really any advantage gained by the departure from the cylindrical type tube-mill," Mr. J. C. Farrant believes he gives a conclusive answer in favour of the conical mill, when he cites the example of the 7 by 12 ft. tube at the Morning mine, of the Federal Lead Company, using 14% less power after being converted into a Hardinge mill. Does Mr. Farrant stop to consider that after the change was made the cubical contents of the converted tube, its unbalanced load, and consequent work done, were less, so that in obtaining this reduction in power he also obtained a less tonnage? If Mr. Farrant could show that the horse-power per ton was 14% less with the same feed and the same discharge, then his conclusion, as far as the large diameter and short tube-mill is compared, could be admitted, but there would still be the factor of the smaller diameter and longer tube-mills fitted with the adjustable discharge.

An interesting discussion on such a mill and the conical mill has recently been concluded in the American technical press between the 8 ft. by 22 in. conical mill at the Morning mine of the Federal Lead Company, and the 5 by 14 ft. adjustable quick-discharge tube-mill at the adjoining Gold Hunter mine, where it has been demonstrated that this latter design of tube-mill will give a granular

product to any degree of fineness suitable for concentration. The comparative results showed that the mill did 3.3 tons per horse-power, equal to 0.305 h.p. per ton, and the 8 ft. by 22 in. Hardinge, 2.8 tons per horse-power, or 3.56 h.p. per ton, and took 17% more power per ton, while the pebble consumption of the Hardinge mill was 2.43 lb. per ton and but 0.7 lb. for this tube-mill. Both of these mills had the same effective cubical content inside the lining, namely, 200 cubic feet, the tube doing 141.28 tons for 43 h.p. against the conical 115 tons for 41 h.p., both re-grinding jig-middling through 20-mesh.

My notes show that the 7 by 12 ft. tube at the Morning mine mentioned in Mr. Farrant's article had a capacity of 250 tons for 90 h.p. grinding through 20-mesh or 2.8 tons per horse-power, before being converted, which is the same as shown by the new Hardinge mills, afterward installed at the Morning mill. Would Mr. Farrant give the total tonnage and horse-power of the converted mill, so that a correct comparison can be made?

Mr. Farrant mentions that the largest Hardinge mill is at the test-mill plant of the Inspiration Copper Co., in Arizona, which will be the largest and should be the most modern copper mill in the United States, with a capacity of approximately 10,000 tons per day. It is at this mill that Mr. Drucker's question should be answered conclusively, in the near future, not only for power and pebbles, but class of product for the work. Tests will shortly be made between the large 10 ft. diam. by 28 in. wide cylinder Hardinge mill and a 6 by 20 ft. Chalmers & Williams adjustable quick discharge tube-mill, both grinding to a 60-mesh product. Mr. Drucker in his article in your May issue states that he believes the tube-mill may be called upon to do any degree of grinding, depending mainly upon the length, diameter, and area of discharge, and I agree with him as to this, but do not believe that it can be most successfully demonstrated with the large diameter and short length tube having the standard overflow discharge. My observations led me to believe that between the large diameter and short length mill and the conical mill there is practically no difference in tonnage per horse-power when crushing to 20-mesh. I believe, however, the shorter diameter and longer mill with its adjustable quick discharge feature, such as above described, will reduce the power per ton, under the same conditions, at least 15%, while the pebble consumption

would also be at the least one-half of that of the conical mill.

JULIUS I. WILE.

Chicago, July 17.

[Mr. Wile is, we believe, connected with the firm of Chalmers & Williams. On the other hand, Mr. Farrant is the London representative of the Hardinge Conical Mill Co. —EDITOR.]

Fiscal.

The Editor:

Sir—In reading your magazine I noticed in the editorial column of your March number a criticism of the use of the word 'fiscal' in connection with report made by the Casey Cobalt Mining Company. This is a word that I have used for a great many years in exactly the same manner as it was used by the company you mention, and I was therefore rather interested in your definition of the word.

One of the definitions, as given in the Century Dictionary and Cyclopedia, published by the Century Co. of New York, is as follows:

FISCAL YEAR, the financial year of the treasury of a government; hence, the period at the end of which the accounts of any public office or treasury, or of any business enterprise or firm, etc., are made up, and the books balanced.

Would not this cover the word as used by the Casey Cobalt Mining Company?

C. A. THOMAS.

Dawson, April 24.

Molybdenite.—As is well known, this mineral lends itself readily to flotation treatment. Mr. Walter McDermott informs us that recently four separate parcels of high-grade ore, amounting to 104 tons, have been treated in London by the Elmore process, with profitable results to the shippers. The ore was crushed to 30-mesh, and yielded in a single operation a concentrate containing 84.8% of MoS_2 , with an extraction equal to 91.7%. In a mill now in regular operation on ore running less than 1% of MoS_2 , a concentrate carrying over 80% of MoS_2 is produced. If the nature of the ore requires it, material coarser than 30-mesh can be treated, which is a great advantage with a mineral of the flakey character of molybdenite. We understand from Mr. Walter Broadbridge that the Minerals Separation company has made sundry successful experimental runs on molybdenite ore, and that with a low-grade ore, a high-grade product has been obtained by successive concentration.

THE ORIGIN OF PETROLEUM.

Deposits in the Gulf of Suez affording an argument in favour of the organic theory.

By ARTHUR WADE and S. ROY ILLINGWORTH.

Introductory.—In the realm of science there is no subject around which controversy has raged more persistently or with less satisfactory or more inconclusive results than the question of the origin of petroleum. For upward of a century brilliant chemists and geologists have debated the problem from their different points of view, and still we remain in doubt, although more recently the tendency has been toward the conclusion that petroleum originates in some way or other, not well understood, from organic matter decomposing in shallow marine, lagunal, or estuarine conditions. Yet nothing is certain. The inorganic school has become more and more ingenious in its experiments, and in its theories. The organic school still hesitates between animal or vegetal origin, or both, under different conditions. Any fresh light, therefore, that can be shed upon the subject is valuable from whatever point of view it may shine, and so we need not apologize for offering our own contribution to the controversy.

Geological. — (Arthur Wade) — During many years I have had opportunities to study the shallow deposits in the Gulf of Suez and in the northern parts of the Red Sea. There, in the warm and shallow waters covering the fringing reefs of the islands and in the shallow bays, thrives a fauna of microscopic animal life, which is extraordinarily rich, and which is frequently accompanied by a shallow marine flora that is both varied and important. Living, dead, and decaying, these forms of life accumulate in places, forming mud and sand almost every particle of which is due to their existence. Foraminifera, sponges, algae, seaweeds and other lowly forms of life, both plant and animal, living and dead, form the mass that is accumulating in salt water, at most a few feet deep, and always at a comparatively high temperature. In the summer months I have taken readings of above 40° C. in the water on these reefs, which I have also proved to be considerably more saline than the waters of the Red Sea itself. The surface of these deposits is usually grey or light-brown in colour—grey where plant life is abundant, light-brown where it is scarce. But when one

probes below the surface, the mud is found to be black in colour, with a strong smell of hydrocarbons and sometimes of sulphuretted hydrogen. After noticing these deposits, especially in the gulfs of Jemshah and Zeitia, on the reefs surrounding Ranim island, and on the coasts of Sinai, especially toward the head of the Gulf of Suez, I proceeded to open them up by means of shallow excavations, in order to find whether there was any chance that the hydrocarbons present were percolating through from the coral reefs below; but in no case could I find evidence of this. The solid rock was in all cases clear and fresh, and showed no traces of such compounds, so I was supported in my conclusion that they were being formed now from the decomposition of the organic matter present in the mud and under the conditions now prevailing on the shallow reefs. This is no very original observation for this district, for the presence of petroleum had already been noted* among the decomposing organic materials on the coral reefs of the Red Sea, while Potonié, working with the Austro-Hungarian Deep Sea Expedition, found petroleum in the mud on the floor of the Gulf of Suez.† However, it seemed to me that we could carry these investigations a stage further, and obtain more evidence. I, therefore, took samples of the muds and sands wherever possible for the purpose of careful chemical and microscopical examination. My colleague, Mr. S. Roy Illingworth, undertook the former, while I embarked upon the latter.

Referring first to the microscopical work, I found both sands and muds to consist almost entirely of organic material, the only exceptions being a few sparsely distributed grains of quartz, which were evidently wind-borne. The rest consisted chiefly of foraminifera, remains of sea urchin, fragments of coral, sponge spicules, and some remains of vegetable origin. But along with these I detected the presence of minute organic bodies of the nature of bacteria; tiny cellular structures of a very simple nature, which may play an important part in the study of our problem.

* Bull. Soc. Nat. Neuchâtel VIII., 58-61.

† Chemische-Geologische Arbeiter der 'Pola' Expedition. Sichert interest. Geogr. Kongr., II., 326-333, 1901.

Chemical examination of Specimens.

—(S. Roy Illingworth)—Dr. Wade handed me two samples for chemical examination; one was a specimen of dry sand contained in a wooden box; the other was a sample of mud that had been collected in a glass bottle. The second sample consisted of a black solid accompanied by a quantity of water, and it emitted a strong smell of sulphuretted hydrogen when the bottle was opened; a lead-acetate paper was immediately blackened when held near the mouth of the bottle. The solid part of the mud was separated by filtration from the water accompanying it, and the air-dried product thus obtained was examined in the same manner as the sample of dry sand. The method of investigation followed was as under.

A known amount of the sand was extracted in small quantities at a time with ether that had been neutralized and re-distilled. The extraction was carried out in a Soxhlet apparatus using a thimble to contain the sand. As soon as one charge of sand had become completely extracted, it was removed from the thimble to make room for a fresh supply. In this way the whole of the sand available was extracted with about 100 c.c. of ether. The flask containing the extract was placed upon a water-bath, and after the major portion of the ether had been distilled off, the residue was transferred to a small separating-funnel of known weight. This funnel was supported in hot water to remove all traces of ether, and also to separate the water contained in the oil. After separation of the water, the funnel was again weighed; and the weight of oil in the sand thus determined.

The sand was found to contain 0·3% by weight of a dark brown viscid oil, while in the case of the solid portion of the mud only a small quantity of oily matter was extracted, which amounted to less than 0·05% by weight. The oil from the sand amounting to 14 c.c. was then examined with the following results:

The gravity of the oil at 60° F. was 1·013. A quantity of the oil placed in a small tube attached to a thermometer and supported in an air-bath began to distil at 150° C. The sulphur in the oil amounted to 0·78%.

The oil was next examined to determine whether or not it was of a wholly mineral nature. About two grammes of oil were weighed out into 20 c.c. of neutral alcohol, warmed on the water-bath, and then titrated with alcoholic potash, using phenol-phthalein as indicator. An excess of potash was now run in, and the heating continued under a re-

flux condenser for two hours, the excess of potash being determined by titration with semi-normal acid, after diluting with sufficient water to reduce the alcohol to a 60% strength. This determination pointed to the oil as containing a small amount of saponifiable matter which, of course, might or might not be of the nature of an animal or a vegetal oil. Certain classes of sulphur compounds might, for instance, be the cause of this result, but strength is lent to the view that animal or vegetable oil or wax is present by the following repeat experiment.

This second determination was carried out upon five grammes of oil, using a greater excess of alcoholic potash for the saponification, and titrating back with deci-normal acid. Further, at the conclusion of this determination, the alcoholic layer was separated from the oil, and the alcohol removed by distillation. The residual liquid in the flask was then extracted with ether, the ethereal layer removed, and the residue distilled to remove ether, acidified, and again extracted with ether. This second ether extract contained a light-brown waxy solid, free from the smell of naphthenic acids, and it melted at 80° C. when floating upon water. The oil separated from the alcoholic layer was washed several times with hot water, and then filtered through a small wad of filter-paper. The sulphur in this product was found to be equal to 0·58%. The difference between this value and the original value is hardly enough to account for the saponifiable matter found, even if one assumes that in titrating with acid any sulphur compound that might be formed with the caustic potash is not affected by the acid. It may be here mentioned that the original oil was free from nitrogen. From these experiments it is justifiable to assume that the saponifiable matter is in all probability of the nature of a vegetal or animal oil, and upon this basis the following results were obtained.

| | Experiment I. Grammes | Experiment II. Grammes |
|--|--------------------------|---------------------------|
| Weight of oil..... | 1·7050 | 4·8565 |
| KOH required for free acid per 100 grammes of oil..... | 0·28 | 0·30 |
| KOH required for saponifi- able matter per 100 grammes of oil..... | 0·802 | 0·821 |
| Amount of saponifiable mat- ter (19·5 KOH=100 oil)..... | 4·11% | 4·20% |

The small trace of oil extracted from the mud was similar in appearance to the oil obtained from the sand; it had a decided odour of petroleum, and it did not char when warmed with strong sulphuric acid.

The sand and mud, after the extraction with

ether, were spread upon a paper to remove the adhering ether, and then analysed, when the following results were obtained :

ANALYSIS OF SAND AFTER EXTRACTION.

| | % | |
|---|--------|---|
| Moisture | 1.14 | |
| Organic matter | 10.66 | Nitrogen = $\begin{matrix} 0.28\% \\ 0.25\% \end{matrix}$ |
| Insoluble in HCl (SiO_2) | 13.18 | |
| Fe_2O_3 and Al_2O_3 | 1.00 | |
| CaCO_3 | 72.28 | |
| CaSO_4 | 1.70 | |
| NaCl | 0.18 | |
| Magnesium salts and phosphate | traces | |
| | 100.14 | |



MAP SHOWING LOCALITY OF INVESTIGATION.

ANALYSIS OF SOLID PORTION OF THE MUD AFTER EXTRACTION.

| | % | |
|---|--------|---|
| Moisture | 1.15 | |
| Organic matter | 6.56 | Nitrogen = $\begin{matrix} 0.12\% \\ 0.11\% \end{matrix}$ |
| Insoluble in HCl (SiO_2) | 24.90 | |
| Fe_2O_3 and Al_2O_3 | 1.88 | |
| CaCO_3 | 64.83 | |
| MgSO_4 | 0.78 | |
| NaCl and phosphate..... | traces | |
| | 100.10 | |

The organic matter was estimated by the ignition of a known weight of the substance, and then re-carbonating the residue by repeatedly treating it with ammonium carbonate until a constant weight was attained. The percentage loss in weight, diminished by the percentage of moisture present, was regarded as the amount of organic matter present. In the preparation from the sand of an aqueous extract, the solu-

tion, when near the boiling point, behaved in a manner similar to starch under such conditions, that is to say, the solution frothed and a gelatinous mass was formed throughout the liquid. Tests for starch showed negative results. The aqueous extract, after evaporation to dryness, left a residue that readily charred on heating with sulphuric acid, and that after ignition left only a very small residue of salt. The 'water-solubles' from the sand as well as from the mud sediment gave a precipitate with an acid solution of mercuric chloride, and, in addition, both these extracts threw down a white flocculent precipitate after they had been treated with alcohol. A saturated solution of ammonium sulphate also caused the deposition of a white precipitate. Filtration of the precipitate from the alcohol treatment was slow, the dried residue left no ash, and nitrogen was readily detected in this product by the Lasigne test. This nitrogenous body thus present in both the sand and the mud appears to resemble a protein; and a nitrogen estimation of the small quantity I was able to isolate gave the amount of nitrogen present as equal to 9.8%, which figure I offer with reserve. Treatment with KOH of the



MICROPHOTOGRAPH OF SAND SHOWING FORAMINIFERA AND FRAGMENTS OF CORAL.

residual sand, after it had been extracted with water, removed a further quantity of nitrogenous matter, which was thrown down on acidifying the solution. Estimation of nitrogen in the original air-dried sand and mud gave a mean figure of 0.25% and 0.11% respectively. This estimation was made by the Kjeldahl method, operating upon five grammes

of the substance after it had been treated with hydrochloric acid and ferrous sulphate and then evaporated to dryness. The ammonia formed was distilled into 100 c.c. of semi-normal sulphuric, and the volume of the distillate made up to 500 c.c., of which 50 c.c. was titrated back with centi-normal caustic soda.

The examination of the water separated from the mud showed it to contain 0.3% of sulphuretted hydrogen, and small traces of salt and ammonia, the latter being detected by the Nessler test. It should be noted that this water layer showed distinct traces of oil upon its surface.

The above examination thus shows that the sand contains a distinct amount of oil, while the mud contains definite traces. The oil from the sand appears to have a considerable content of saponifiable matter, that is, matter derived from the vegetable or animal kingdom. Furthermore, the oil-free sand and mud contain organic matter. Of more importance still, they contain nitrogenous matter of the nature of a protein; that is, they contain a type of substance absolutely characteristic of the plant and animal world. What other conclusion can be drawn from these facts, than that the oil represents a degradation product of animal and vegetable matter? Can any conceivable 'solfataric' or 'inorganic' theory harmonize with the above facts? As far as I am aware, this is the first recorded instance of nitrogenous organic matter being found in oil-containing sand, and perhaps further examination of such sands and their accompanying oil will no doubt bring to light other instances. It is in these directions that we must look for the solution of the problem of the origin of petroleum. The mere fact of being able to produce petroleum-like products by chemical means in the laboratory cannot alone carry much weight. No chemist would assert for one moment that because he can produce an alkaloid by an elaborate synthesis, therefore Nature perforce must have produced it in the same way.

Conclusion.—It is not necessary to go here into the work done by others in the same direction. An excellent résumé of such work has already been given by Mr. Leonard Dalton.* But it seems to us that our investigations can point to one conclusion only. In no case could these muds have been affected by solfataric conditions. They rest above thousands of feet of ordinary sediments, chiefly calcareous in nature. Moreover, these oil-

bearing sediments are associated with the gypsum and salts that are now being formed under similar conditions. One of us has shown elsewhere* how the sea-water is sucked up by the dry desert sands, and how salt and gypsum crystallize out in concentric areas near the shores, the salt near in to the shore and the gypsum farther away. This may account, to some extent, for the association of salt and gypsum so frequently with petroleum, although it plays no close and active part in its formation. Such an association is simply indicative of the conditions under which the petroleum-bearing strata were laid down. Unfortunately, these deposits cannot lead to some future oil supply, for the shores of the Red Sea are rising, and the materials will soon be elevated and 'decarbonized.' If, however, the land were being gradually submerged in this area, these deposits would certainly accumulate to considerable thicknesses, gradually encroaching on the sinking land until they would cover a wide area. In this way an oil-field of considerable extent would be formed. We may be sure that somewhere in the world such conditions do exist. They await investigation. It is certain that they once did exist in this area, for the oil supplies which are now being tapped at Jemsah, and which are in evidence elsewhere, are accompanied by the strongest possible evidence that they were formed during a period of submergence in exactly this manner.

The presence of bacteria in the decomposing mud is what might be expected. Others have suggested their part in the origin of petroleum. As yet their mode of action is uncertain, but we do know the amazing chemical changes produced by these organisms in other cases. Why should we not know sufficient one day to enable us to prepare suitable cultures of bacteria in proper surroundings to enable us to produce at will petroleum by this means?

* A. Wade, *Quarterly Journal Geol. Soc.*, 'The Eastern Desert of Egypt.'

The Institution of Petroleum Technologists has issued the first number of its *Journal*. This contains a report of the inaugural meeting held on March 3 last, when Sir Boverton Redwood read his presidential address, and Mr. E. H. Cunningham Craig and Professor Vivian B. Lewes made supplementary statements relating to the aims and possibilities of the new society. The paper by Sir Thomas Holland is also printed; this is devoted to geometrical problems in connection with the determination of the axis of hidden anticlines.

* 'On the Origin of Petroleum.' *Economic Geology*, Vol. IV. No. 7, pp. 603-631, 1909.

IMPRESSIONS OF JUNEAU, ALASKA.

By FREDERICK CLOSE.

JUNEAU and the district around is most interesting from a mining engineer's point of view. On the island opposite is the Treadwell group of mines, which have already produced 22 million tons of ore with a recovery of \$2'42 per ton; in the hills nearby the new mills of the Alaska Juneau and Gastineau mines are being erected; while the Ebner and Alaska Treasure, two more large low-grade properties, are being actively prospected with a view to the building of mills next year.

The following notes are based on observations made during a recent visit. The operating costs of the Treadwell group for 1913 were as follows:*

| Cost per ton milled | Mexican | Treadwell | United |
|---|----------|-----------|----------|
| Mining and development | \$0'9070 | \$0'8271 | \$1'0452 |
| Milling | 0'2510 | 0'2476 | 0'2462 |
| Cyaniding concentrate | 0'0923 | 0'0880 | 0'0966 |
| Offices at San Francisco, London and Paris..... | 0'0260 | 0'0207 | 0'0131 |
| Taxes, legal, bullion..... | 0'0336 | 0'0264 | 0'0291 |
| Operating cost | \$1'3099 | \$1'2098 | \$1'4302 |

Obviously, in order to keep costs down to these limits, the organization must be splendid and the facilities for mining and milling exceptionally good. The dominant factors are wide lodes and a docile ore, water-power, supplemented in winter by oil-burning steam-plants, and a site at tidewater.

In the stopes, 30 tons of ore are broken per machine-shift. The stopes require no timbering. Pumping costs under 2 cents per ton of ore. Hoisting through vertical shafts at the Treadwell and Mexican mines costs 8½ cents per ton, but at the Alaska United mine, the workings of which are under the sea, hoisting by incline-shaft costs 17 cents per ton. The increased cost of hoisting in an incline shaft is notable.

The shrinkage system of stoping is used. The ore breaks in lumps, weighing up to 30 tons or more, requiring an appreciable expense for 'bulldozing' or blasting, before it will run down the chutes.

Carbide lamps burning for four hours, attached to the miner's cap, are used throughout. The miners are supplied with spare tins of carbide before going on shift.

Most of the machinery can be run by water or steam alternatively. Owing to the contour

of the country no large reservoirs can be made economically on Douglas island, so the quantity of water available for power varies from day to day according to the rainfall (which is depressingly continuous from a residential point of view) or the melting snow. Air-compressors, for instance, have Pelton wheels about 25 ft. diameter in place of fly-wheels. The steam cylinders can be disconnected, but most of the time steam has to be used to supplement the water. More water-power is now being harnessed on the mainland, but the de-



mand exceeds the supply obtainable within a radius of 30 miles, and this demand will increase largely as other mines come to the producing stage. There is an excellent opening for a central power-supply company to generate 30,000 to 50,000 kw. 35 miles away and transmit the power to Juneau for distribution among the various consumers, as the capital cost of the line would be too great for one mining company to develop and transmit power for its own consumption only.

A flow-sheet of the Treadwell group of mills is delightfully simple. A central crushing-station and sampling mill has been installed recently, ore being crushed to 2 in. before delivery by rail to the various mill-bins. The 1250-lb. stamps crush through 25-mesh, the total ore crushed in the four mills per 24 hours being 4300 tons. The stamp-duty is 4'8 tons. The pulp from the stamps flows over amalgamation plates; thence it is distri-

* Mining & Scientific Press, June 13, 1914.

buted upon vanners treating 14 tons per 24 hours. The concentrate is trammed to the central cyanide plant, while the tailing flows to waste, or to make excellent baseball grounds on the fore-shore.

To the man versed in copper or tin mining, accustomed to close classification by hydraulic or screen devices, or both, followed by banks of tables for the various sizes, dewatering cones, re-crushing machinery, further classification, slime-tables, etc., etc., it looks absurd to run unclassified ore crushed to 25-mesh direct on to vanners and expect a high recovery. But the tailing assay is between 20 and 25 cents the exact amount is uncertain owing to the limitations of practicable methods of assaying. Various exploiters of different types of concentrating machinery have been given a free hand to experiment with the feed or the tailing as much as they liked; after fair trial all have abandoned any hope of making a commercial improvement and have departed sadder but wiser men. What more is there to say?

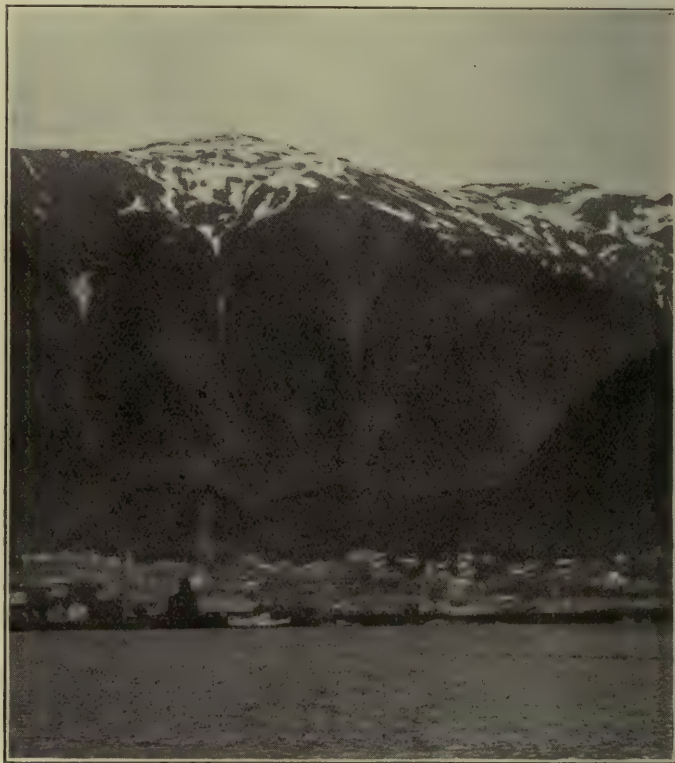
The ratio of concentration is nearly 50 into 1. Ninety tons of concentrate assaying \$60 or \$70 is trammed to the central cyanide plant per day, and is ground in cyanide solution (2 lb. per ton) to 200-mesh in tube-mills, thence to air-agitation and decantation vats. Precipitation is effected by zinc-dust, the feeder being run by a belt connected to the pregnant solution pump; hence the feed is always proportional to the quantity of solution. The zinc-dust is brightened before use in a small tube-mill. The recovery by cyanide is 97%, the latest cost being \$2.75 per ton. Amalgamation was practised in the tube-mills, but was found unnecessary.*

The men are well looked after, the bunk-houses, club-rooms, boarding-houses, etc., being on a lavish scale; there is a splendid bath-house and swimming pool. A deduction of \$1 per day is made for board, but the men are not compelled to board at the mine. Unskilled labourers are paid \$3 per day.

* For further details I refer the reader to 'The Cyanide Plant at the Treadwell Mines,' by W. P. Lass. Trans. A.I.M.E. Vol. XLIII. Pp. 785.

Passing to the Alaska Gastineau mine, or Perseverance, as it used to be called, the outstanding features are the large scale of working, large initial capital expenditure, and the novelty of the flow-sheet as applied to gold mining.

An 8½ by 10½ ft. adit, to transport the ore to the mill on Sheep creek, was driven through hard slate and greenstone at an average speed of 548 ft. per month for a length of nearly



JUNEAU.

Alaska coast range in background; Gastineau Channel in foreground.

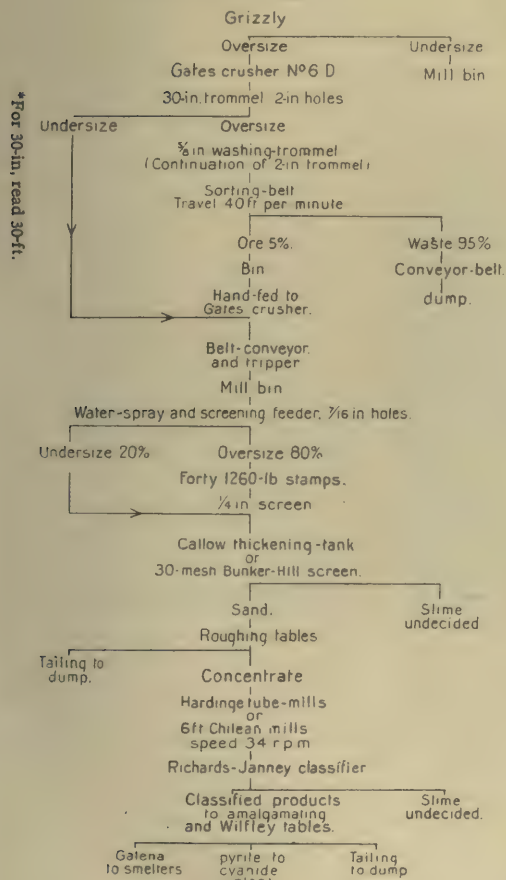
8000 ft. The best monthly progress was made in November 1913, when 661 ft. was driven. Three shifts were employed; each shift worked 6 hours at the face and took 12 hours off. This resulted in a complete cycle of operations every three days and a 56-hour week for the men, exclusive of the time required to get to the face and back. The day's pay plus bonus system was used, four 6-hour shifts, four machines in the face. The work was done under the supervision of an Irish foreman, a born leader of men. The monthly bonus was given to him in a lump for distribution as he thought fit, a system open to great abuse under a less powerful personality,

and the wages, plus bonus per man employed, averaged \$8 per day.

The Gastineau orebody is wide; it has been found that by beginning a stope next the hanging wall, the ore will break across to the foot-wall, while the miners are protected from falling rock, as they work under the hanging wall only. By this means it has been already

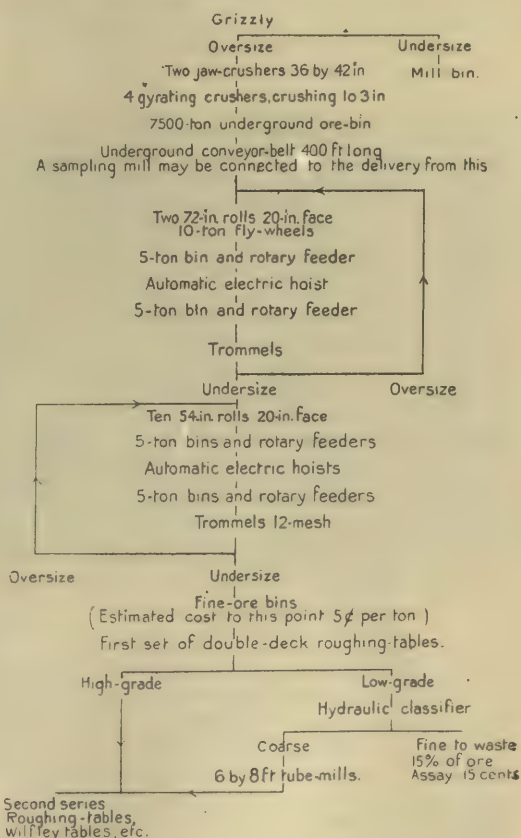
A trestle railway about a mile long connects the mine with the mill. The trestles are being buried under ore and waste taken out while preparing the mine for stoping on a large scale; this seems a wicked waste of good ore, but the grade is not high enough to warrant storing and picking up again. In view of recent editorial decisions in the Maga-

ALASKA JUNEAU MILL.
Outline of FLOW-SHEET of First Unit
Capacity 600 to 800 Tons per 24 Hours



proved that 100 tons of ore can be broken per machine-shift. There is no definite parting on either wall, so it would appear that by this method difficulties might arise in getting the ore to break to the profitable width and no farther, but the management is satisfied that this can be done, and it ought to know. The ingenious grizzly and clearing chambers over the box-holes and the underswung chute-gates are features of the Gastineau method of mining that have already been described in the technical press.

ALASKA GASTINEAU MILL.
Outline of FLOW SHEET of first unit
Capacity 6000 to 8000 Tons per 24 Hours



zine, should all this material be classified as waste?

Storage-battery locomotives are used for hauling.

A pilot-mill has been running for nearly a year. The new mill now being erected was designed from data obtained in the pilot-mill, and it is claimed that the preliminary tests have conclusively proved the practicability and economy of the scheme adopted.

The first unit, with a capacity of 6000 to 8000 tons per 24 hours, will be running early

in 1915. A general outline of the flow-sheet of this mill is given herewith. This is the first large gold mill, as far as I am aware, using rolls to crush the ore. Even as compared with copper mill-practice there are some novel features, as indicated on the flow-sheet; for example, underground ore bin between crusher-station and roll-mill; first rolls weighing 100 tons including the 10-ton fly-wheel; the seven automatic electric hoists, which are loaded from bins by rotating feeders; as soon as the skip is full it is hauled up while the feeder stops, the skip tips into a bin whence the ore is fed to trommels or rolls while the skip descends for another load, the cycle be-

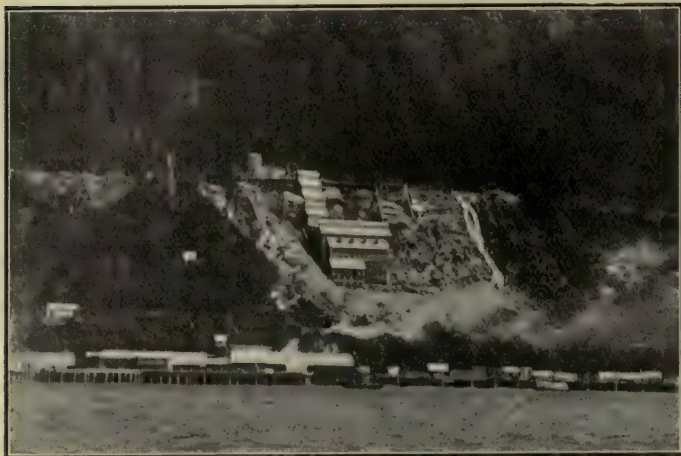
nide. The amalgamation plant will therefore be installed, but cyanide treatment may eventually be adopted. The galena concentrate will be shipped to the smelter at Tacoma.

Mining costs are expected to be about 57 c., crushing to 12-mesh 5 c., concentrating and overhead charges 18 c., total cost about 80 c. per ton. The grade of ore can be kept to \$2, but it is believed that ore assaying \$1½ or even less can be mined and milled at a profit.

The power required is estimated at 0.8 h.p. per ton in the mill and 0.2 h.p. in the mine; total one horse-power per ton per day.

The initial outlay on development work and mill construction will amount to about \$5,000,000; as an American visitor remarked, everything about the Gastineau is on a colossal scale except the quantity of gold per ton of ore, which is minute.

The Alaska Juneau will mine and mill ore of exactly the same nature as the Gastineau, for the two companies are working on the same lode. The Juneau's first mill-unit of about 800 tons capacity follows South African practice, as is shown by the outline of the proposed flow-sheet; the differences between this and the Gastineau's flow-sheet being obvious. Both have made preliminary runs in pilot-mills, the Juneau to a smaller extent than the Gastineau, and yet the results of these preliminary runs



ALASKA JUNEAU MILL.

ing entirely automatic. It is expected that the electric hoists will prove more reliable than belt and bucket elevators.

The ore crushed dry to 12-mesh, as above, instead of passing direct to the concentrator department, is fed into bins, automatic feeders under these ensuring a regular feed to the tables. Double-deck roughing-tables having a capacity of 100 tons per 24 hours will be installed. The presence of a small percentage of galena complicates the flow-sheet slightly as compared with Treadwell; the galena will be separated on Wilfley tables, which will also give the pyritic concentrate a final cleaning. The ratio of concentration will be about 70:1.

Preliminary experiments on the pyritic concentrate have shown that the best commercial result is obtainable by fine grinding in tube-mills and amalgamation, while the highest recovery is obtainable by fine grinding and cya-

lead the two concerns to contrary conclusions.

The Juneau mill is not yet in full working order, but will be running before this article appears in print. Up to the point where the ore leaves the stamp, South African practice is followed closely. The ore, after passing the Gates crusher, is screened in a trommel with 2 in. holes; the over-size is washed in the last 4 ft. of the same trommel from which it is fed into a picking-belt. It is hoped to sort by hand 5% of ore from 95% of waste, but it remains to be seen if this can be done. The Gastineau people say they have tried it and it cannot be done commercially; the waste assays too high, and labour for picking is too expensive.

Shaking-screen feeders are fitted above the mortar-boxes. The under-size from two adjacent screens joins and passes through the centre king-post in a 3 in. pipe, an arrange-

ment that appears to weaken the post and will cause rapid decay.

The exact flow-sheet below the stamps is not yet decided, several alternative schemes being installed. By one scheme the ore from the stamps crushing through $\frac{1}{4}$ in. holes and the under-size from the shaking feeders, which have $\frac{7}{16}$ in. holes, will be dewatered in thickening cones and sent to roughing-tables. It is hoped that these tables will make a tailing clean enough to reject, whereas the Gas-

trating—a figure that will take a lot of beating. If vanners were used at the two former mills, the galena could easily be separated from the pyrite by running the vanner-concentrate over Wilfley tables, and, in view of the excellent work done by the vanners, the decision to depart from them required much pluck.

Gasoline motors are used at the Juneau to haul the ore to the mill, but the heat and smell of the exhaust gases makes them un-



ALASKA GASTINEAU MILL IN COURSE OF CONSTRUCTION.

tineau will make no tailing till the ore has been crushed to 12 mesh. I back Gastineau's opinion in this matter. Further ideas for the Juneau mill are shown on the flow-sheet, which will be modified in accordance with information obtained on test-runs.

The Alaska Juneau mill is perched on a hillside above Gastineau Channel; the slope of the hill is 45°, so steep that it looks as though a good push at the top would send it all down to the water's edge. The country rock, however, is solid, and space for two or three more 800-ton units has already been cleared alongside the present mill.

The comparison of results obtained from the Juneau and Gastineau mills with the Treadwell mill will be interesting and instructive. The Treadwell milling cost for 1912 was only 23 c. per ton—including crushing, tramming to mill, stamping and concen-

trating—a figure that will be scrapped in favour of electric traction.

All this work of development and construction makes Juneau a lively town. It affords a pleasing contrast to other coast cities in British Columbia and the United States, which are passing through a severe depression. Labour has migrated to Juneau rather in excess of the demand, and so is readily available locally. The general economic conditions are most favourable. The management inspires confidence.

When the first units of the Gastineau and Alaska Juneau mills have proved successful, further units will be added, and it is anticipated that these two mines together will be milling 35,000 to 40,000 tons per day in 1919. The total tonnage crushed by all the mines in the Juneau district may then amount to between 50,000 and 60,000 per day.

GEOLOGY APPLIED TO MINING. III.

By T. A. RICKARD.

* COMING to the more direct applications of our science to the art of mining, I know no better illustrations than those afforded by Leadville and Rico, both in Colorado. In these celebrated silver-mining districts the ore is found at definite geological horizons, so that the ascertainment of stratigraphic relations is the first step to intelligent exploration. To Leadville I turn with especial satisfaction because it exemplifies, to an extraordinary degree, the invaluable help that the geologist is enabled occasionally to give to the miner. Moreover, the pleasure of considering so satisfactory an example is heightened by another fact: the geological investigation that unravelled the complexities of rock-structure at Leadville was the work of S. F. Emmons,¹ an illustrious alumnus of Harvard and the American geologist above all others to prove to the miner how good a friend he has in the student of the rocks.

As most of you know, the mining district of Leadville lies on the western flank of the Mosquito range, which consists of a series of sedimentary rocks that have been greatly faulted and repeatedly invaded by intrusive masses of plutonic origin, now appearing as dikes and sills of varying shape. At first the ore was supposed to be mainly confined to the blue dolomitic limestone (Carboniferous) at or near its contact with one of the igneous intrusions, namely, the white porphyry. This was called the 'first contact.' Subsequently ore was found in the underlying white limestone (Silurian) where it was penetrated by, or otherwise in contact with, a later intrusive, called the grey porphyry. This became known as the 'second contact.' But both of these ore-bearing horizons are crossed and dislocated by big faults. Hence it became necessary to the miner to know the extent to which the strata had been displaced, and to ascertain where to search for the contacts along which the ore had been concentrated. To give this information, Emmons made a thorough study not only of the geology in the immediate vicinity of the mines but of the entire region within a radius of 10 miles, thereby

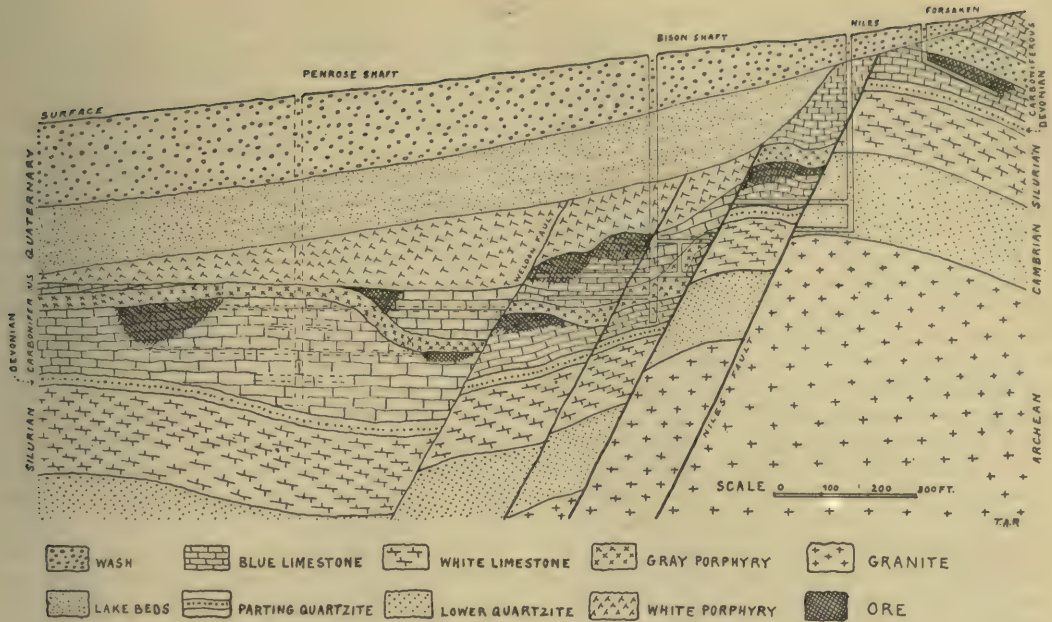
obtaining a comprehensive view of the structural conditions that had modified the localization of the ore. Through the medium of the United States Geological Survey, he gave the mining community a monograph explaining the distribution of ore, together with a series of maps showing plainly the succession of strata below any given spot, as well as the faults that might interrupt the continuity of the ore-bearing horizons. These maps were to the mining engineer underground as charts whereby he steered the course of his exploration; it is not too much to say of them that, measured even in so commercial a unit as the dollar, they were worth to the operators at Leadville many millions. Moreover, they taught those engaged in mining throughout the Rocky Mountain region, and elsewhere, how great was the immediate and practical usefulness of a correct geologic diagnosis of a mining district, quite apart from its obvious presentation of scientific conclusions and its general educational effect. When that report of Emmons first appeared I was a student recently graduated from the Royal School of Mines and serving my first apprenticeship in Colorado. I take pleasure in acknowledging that it was to a Harvard graduate that I owe my first real appreciation of the structural relations of ore deposits. So also it is pleasant to place on record the fact that one of Emmons' principal assistants was Ernest Jacob, an Associate of the Royal School of Mines. Emmons often spoke to me of his appreciation of Jacob's work. Without question, the monograph by Emmons afforded a great stimulus to the application of geology to mining. Geology thereby became justified as a factor in economics.

The experience gained at Leadville prompted an eager search for similar ore deposits; that search was rewarded by the discoveries that are now associated with the names of Aspen and Rico.

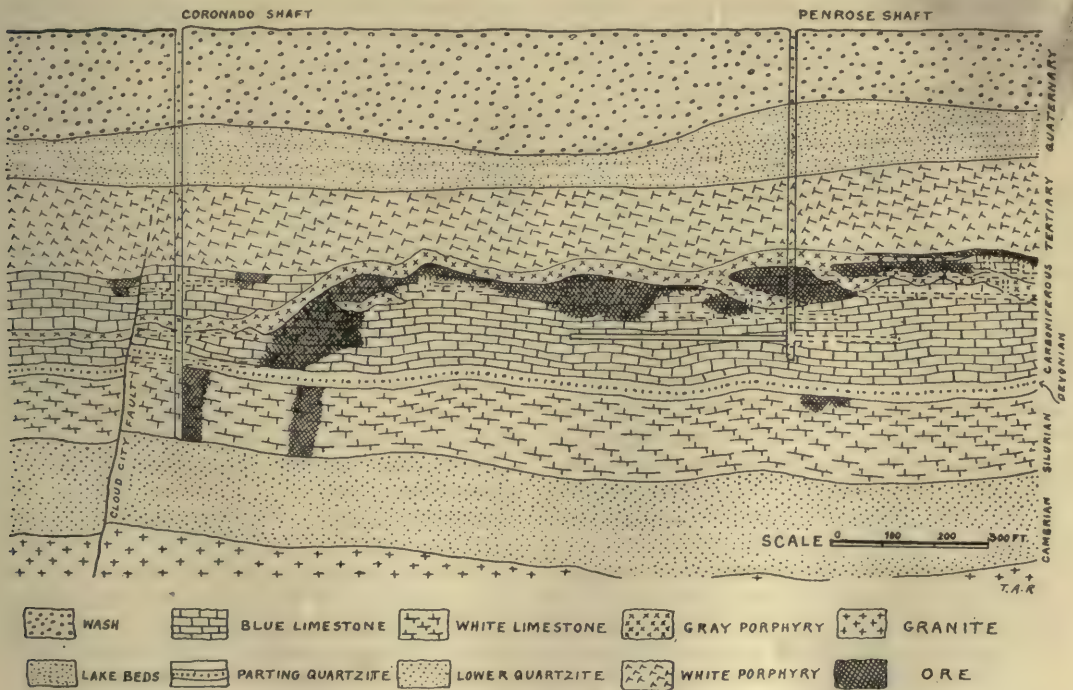
The ore deposits of Aspen were investigated by S. F. Emmons and J. E. Spurr, both Harvard men. Aspen is in a locality where the uplifts of the Sawatch and Elk mountains converge, so that the sedimentary rocks are squeezed, crushed, and faulted. Along the faults, and proceeding from them into calcareous rocks, the ores of silver and lead have

* The third of a series of five lectures delivered at Harvard University in May 1913, and at the Royal School of Mines in January 1914.

¹ 'Geology and Mining Industry of Leadville, Colorado.' By Samuel Franklin Emmons. U.S. Geological Survey. Monograph No. XII. 1896.



A LEADVILLE SECTION. AFTER S. F. EMMONS AND J. D. IRVING.
NOTE THE FOUR FAULTS AND THE REPLACEMENT OF LIMESTONE BY ORE NEAR THE PORPHYRY.



ANOTHER LEADVILLE SECTION. NOTE ASSOCIATION OF ORE IN LIMESTONE WITH PORPHYRY SILL.
ALSO TWO CHIMNEYS OR VERTICAL ORE-SHOOTS ALONG FRACTURES IN LIMESTONE.
AFTER S. F. EMMONS AND J. D. IRVING.

been deposited, in a manner analogous to that observed at Leadville. While porphyritic intrusions do not bulk so large at Aspen, yet intercalations and dikes have played a decisive part in creating conditions favourable to the deposition of ore. The precipitation of metallic sulphides is associated, in this district, with a thermal activity that also changed the limestone into dolomite. The chief ore-bearing horizon is along the upper edge of the Carboniferous limestone, as at Leadville, but in this case the contact is with the overlying Weber shale — also Carboniferous — rather than with porphyry. Where enriched by ore, the shale and the limestone are alike turned into a brown dolomite. Here, as at Leadville, the financial success of mining operations depended largely upon the elucidation of a complex system of faults. This was done by the geologist with a skill which the miner acknowledged with gratitude.

At Rico the ore is found also in beds of Carboniferous limestone not far from intrusive masses of eruptive rock. As manager of the most important mine in this district—the Enterprise, on Newman hill—I had a good opportunity to study the distribution of the ore in relation to rock structure.* The discovery of the first orebody in the Enterprise mine admirably illustrates how ore can be found by accident, and the subsequent finding of many more orebodies will serve even better to show how much more effective is the prospecting that is based upon a correct understanding of the local geology. In 1881 David Swickhimer and his comrades sunk a shaft on Newman hill in the expectation of cutting the continuations of veins successfully worked in certain claims farther south, called the Swansea group. The shaft went through 'drift' all the way for 146 feet. This part of Newman hill has an overburden of 'drift,' or glacial detritus, which covers the true rock-surface of sandstone and limestone in which the veins are found. Thus the veins do not outcrop at the present surface. Another shaft, on an adjoining claim, the Songbird, did reach lime-shale at 203 feet. Both these shafts were in wet ground and were subsequently abandoned. In 1886 Swickhimer, encouraged by the work done in the Swansea mine and more than ever persuaded thereby that the veins could not fail to extend into the Enterprise claim, recommenced the sinking of his shaft. Despite a heavy influx of water and much bad luck, the shaft was sunk into the lime-shale and

struck rich ore at a depth of 262 feet. The ore was one foot thick, it assayed 2 oz. gold and 519 oz. silver per ton, and it formed part of a flat lode. In the light of later knowledge, this discovery was a piece of extraordinary good fortune, for it proved to be one of the biggest orebodies ever found in Newman hill, and it would have been missed if the shaft had been sunk 20 feet to the east. Swickhimer thought that the layer of ore was merely a roll or local eccentricity on the part of the Enterprise, an almost vertical vein. However, he soon satisfied himself that it was a bedded formation, conforming with the enclosing country. The shaft was sunk 60 feet below this 'contact,' and in a drift run westward the Enterprise vein itself was finally intercepted at a point 118 feet southwest of the shaft. The ore in the vein was 20 inches thick and assayed 3 oz. gold and 285 oz. silver per ton. Thus Swickhimer completed a remarkably successful search for ore, finding not only the vein that was the immediate object of his prospecting, but also an orebody as unexpected as it was rich.

The shale, limestone, and sandstone beds of the Rico series are of Lower Carboniferous age; on Newman hill, as we have seen, they are hidden under a cover of Quaternary drift, the maximum thickness of which is about 400 feet. Intrusions of porphyry, more plentiful at the northern end of the hill, explain the activity of ore-forming agencies. The beds are thin and dovetail into each other in the form of flat discs of sediment, indicating that they were deposited in shallow water. The mine workings are largely confined to a thickness of 200 feet, for the veins do not penetrate upward beyond the 'contact' and they become barren at an average depth of 100 feet below that horizon. The use of the term 'contact' was borrowed from Leadville; as a matter of fact there is here no juxtaposition of an eruptive and a limestone, but a thin layer of pulverulent black shale, which is nothing else than the remnant of a former bed of gypsum,* from 10 to 20 feet thick. In places this gypsum survives and contains rich ore.

Turning from this flat deposit of ore we find a double series of upright veins, both of which terminate abruptly in their near approach to the 'contact.' Just below the contact these veins throw out branches or fan out into stringers; and the remarkable fact became disclosed from careful surveys that the

* The Enterprise mine, Rico, Colorado. By T. A. Rickard. Trans. A.I.M.E. Vol. XXVI. Pp. 906-980.

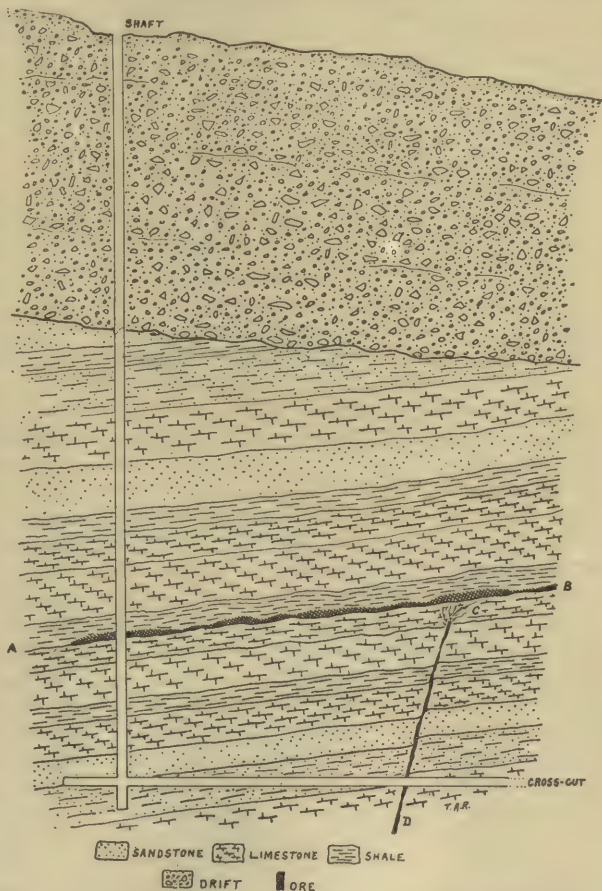
* Geology of the Rico Mountains, Colorado. U.S. Geological Survey. By Whitman Cross and Arthur Coe Spencer. Pp. 274-278.

ore along the 'contact' is related to these veins—capping them, as it were. The ore along the plane of the former bed of gypsum exists in narrow bands that correspond exactly to the strike of the tributary veins underneath, and where several veins apex at this horizon the tendency is for the separate orebodies to merge into one flat mass of ore, such as that found by Swickhimer. That particular orebody (A'A' to C'C' on the accompanying plan) was related genetically to six or seven veins, belonging to the two series. It is necessary to distinguish between two sets of veins, for one has a NE-SW strike and a nearly vertical dip, while the other has a NW-SE strike and a flat dip. The first series is ore-bearing; the second is not; yet both enrich the contact where they apex. The first series is the older, for it is faulted when crossed by the members of the second series. The first are called 'verticals'; the second are called 'cross-veins.' Finally, even the 'verticals,' which carry ore for a varying distance below the 'contact,' became so impoverished at 100 to 150 feet in depth as to be no longer mined at a profit.

These structural features are rendered distinct by the thin bedding of the country-rock, for the beds of limestone, shale, and sandstone range from a few inches to 4 or 5 feet only; similarly, the veins are only 2 or 3 feet thick when most productive; and the ore on the contact is a thin layer that is thickened in places to 3 or 4 feet at the most. The sedimentary beds are dark-grey to black; the ore itself consists of white quartz and pink rhodochrosite, speckled or ribboned with black sulphides; hence a delightful contrast of colour is afforded, facilitating observation and aiding the portrayal of the structure by pencil or camera. It remains to add that the veins mark lines of minor faulting; the so-called 'verticals' are richest when most nearly vertical; they are also most productive in sandstone, in which they usually straighten, while in shale they may show sympathy with the lamination. The cross-veins consist of white quartz, often in a crushed condition, indicating later movement. In places they have been dislocated by such movement.

The faulting of the ore-bearing veins by the barren cross-veins, and of both by later dis-

locations, is a fact important to the mine manager, who is concerned to follow the ore of the one system and to calculate both the amount and direction of the faulting produced by the other system. The direction of throw is often indicated by the 'drag,' that is, fragments of ore torn from a vein and carried along the line of movement. Occasionally the 'drag' has been mistaken for ore in places,



ILLUSTRATING THE DISCOVERY OF THE ENTERPRISE OREBODIES.

causing blunders in mining. The extent of the faulting can be gauged by the fact that when we were running half-a-dozen drifts, on as many ore-bearing veins, we encountered a fault about once a month in each drift, that is, the distance between faults ranged from 65 to 100 feet, on average. Obviously a good deal of work and money could be squandered in an aimless search for the broken ends of faulted veins. Indeed, in the early operations the finding of them was haphazard and expensive, even when successful. Here is where the scientific man had a chance to aid industry.

He did, even if it was not done with all the assurance that might have been desired. Out of over 200 instances of faulting noted during my first year's management of the Enterprise mine, I detected only one (and that was doubtful) exception to a rule of faulting enunciated by Carnall and Schmidt, and phrased as follows:

"If the fault be encountered on its hanging-wall side, after breaking through it, prospect toward the hanging-wall side of the vein; on the contrary, if from the foot-wall side, then prospect toward the foot-wall side of the vein."^{*}

This rule is an assumption of the line of quickest descent as expressed in geometric terms; it applies only to normal faults. However, even with this limitation, it proved a triumph of scientific deduction as tested in the Enterprise mine. I applied it gingerly at first, and confidently afterward, being enabled thereby to save lots of useless cross-cutting and to find much rich ore. In other districts other rules may be found more applicable; at Rico it expressed the habit of the veins and afforded a working hypothesis of the greatest practical utility.

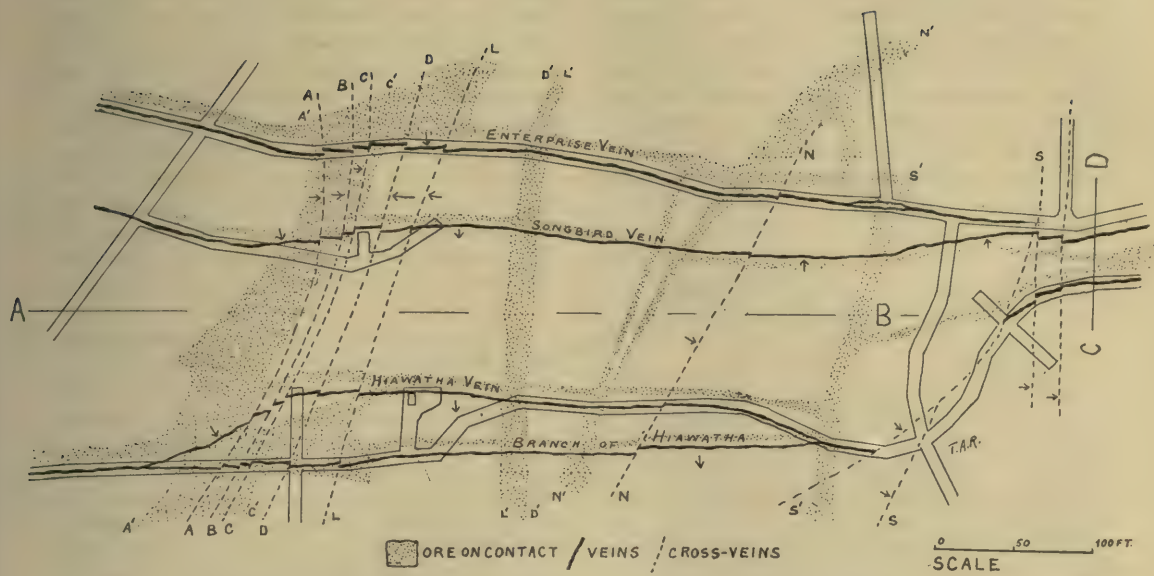
I have outlined the relation of the contact to the two systems of vein-fracture in so far as that relation affected the distribution of ore on the contact. The application of the fact, whatever might be its geological explanation, proved most useful in the search for ore. Here let me suggest to you that the ascertainment of a fact by observation is often of immediate importance to the miner even when the scientific theory explanatory of the fact is of doubtful value. Thus it was the custom to grope for ore along the contact by extending cross-cuts and drifts into the untried parts. As no guiding idea was available, this exploratory work scored many failures to each success, and it was all the more expensive because the soft nature of the black shale made the ground 'heavy,' that is, it required constant re-timbering owing to shrinkage due to pressure. When, however, I had ascertained the fact that the orebodies of the contact were definitely related to the veins coming up underneath, the search for ore became intelligent. The dip of every vein was projected on the cross-section of the mine, and search was made for ore where that line intersected the horizon of the 'contact.' If a new cross-vein was cut in a drift, a survey was made so as to ascertain where it also would meet the

'contact.' Where several veins happened to apex near each other or where the apices of a vertical and a cross-vein were close together, there the chances for ore were best. Of course, some blanks were drawn. Every vein was not capped by an orebody; some of them yielded only a scattering of rich ore, while others were crowned by a more nearly continuous body of low-grade material. However, no ore was found save in such relation to a vein, and the map of the contact exhibits unmistakable evidence of the relationship established by geological inference.

The mine was opened by means of adits, which also served to test some of the veins in depth. Drifts going northeast gained distance from the 'contact' and early gave proof that even the 'verticals' soon became impoverished. Deeper adits and prospecting from shafts in adjoining properties confirmed this unpleasant fact. Yet it was resolutely disregarded as long as possible. When Swickhimer, as we have seen, first penetrated into ore on the 'contact,' he thought he had cut a flat vein. Later, when the workings had proved that the ore conformed to the bedding of the shale, the idea was started that Rico had a limestone-shale contact similar to that of Aspen and resembling the ore-bearing zone in the Carboniferous limestone at Leadville. Despite the evidence obtained in the wake of development in regard to the relationship between the ore on the contact and the veins impinging from below, the Leadville tradition was hugged, until finally there arose talk of a 'second contact,' resembling that of the white limestone and grey porphyry at Leadville. Boreholes and shafts were sunk in the expectation of finding such a zone of ore, but they failed utterly. Analogy is a dangerous instrument, especially when applied with eyes wilfully closed.

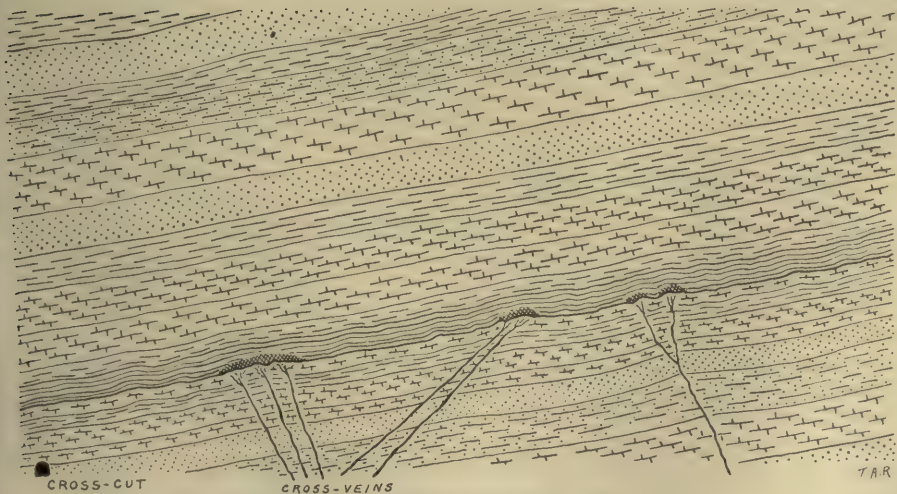
It remains to draw two lessons. First from Leadville: There the geological survey of the surface, followed by deductions affording data for the construction of a map exhibiting the rock structure underground, proved of more immediate use to the miner than any theory attempting to explain the origin of the ore deposits. As to the latter, we still engage in disputation; as to the former, we accept the coloured chart with gratitude, for the correctness of it has been proved repeatedly by mining operations during the past 27 years. Emmons came to the conclusion that the porphyries were the immediate source of the ore, by the agency of descending waters, which found a soluble rock in the limestones and

^{*} 'Fault-Rules.' By Francis T. Freeland. Trans. A.I.M.E. Vol. XXI. Pp. 499.

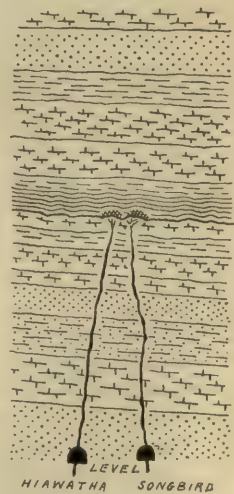


PLAN OF A PORTION OF THE ENTERPRISE MINE

SHOWING OREBODIES ON THE CONTACT, TOGETHER WITH THE VEINS FROM WHICH THAT ORE ORIGINATED.



SECTION A-B



SECTION C-D

THESE SECTIONS SHOW THE RELATION OF THE VEINS TO THE OREBODIES ON THE CONTACT.

there affected a chemical exchange that resulted in the deposition of silver-lead minerals in large masses. What may have been the ultimate source of these minerals, he did not venture to say. The later attempts of others to solve this problem have usually ended in vague references to a source somewhere 'below.' I do not hesitate to assert that in directing his scientific investigation toward ascertaining the



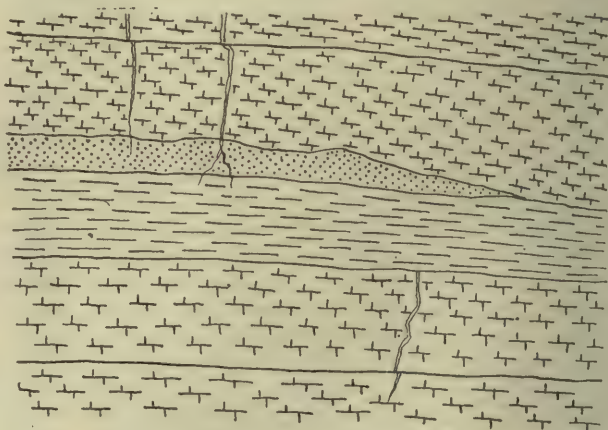
'VERTICAL' FAULTED BY 'CROSS-VEIN'
SHOWING FRAGMENTS OF ORE IN PATH OF FAULT.

particular conditions modifying the localization of ore, Emmons did much more for mining than by any theorizing upon the origin of that ore. He was thoroughly in touch with the men in charge of the mines and he knew the sort of guidance that would help them most. Such guidance he was enabled to give them. Whatever may be the ultimate source of the ore, it is the *last* process of concentration that has formed the orebody as found today by the miner. He wants to know what conditions have modified the final concentration, so that he may search for such favourable conditions as a preliminary to finding ore. He asks the geologist to tell him where the ore is likely to be *now*, not where it was formerly or whence it came. The latter is interesting; the former is of transcendent economic importance.

Second, from Rico: Here also the recognition of the structural relations was more immediately useful to the miner than any theory explaining the genesis of the ore deposits. For instance, it is interesting to know that the contact marks the position of a former bed of gypsum, but it proved more important to the mining engineer to recognize the existence of a definite horizon above which the veins did not extend and along which they formed a layer rich in ore. The further fact that this ore existed in bands corresponding to the strike of two systems of veins was more to the point than any discussion of the immediate connection between the ore deposition and the porphyrite, which had penetrated the

Carboniferous strata and had been in all probability a prime factor in giving life to the thermal waters that had circulated along the vein-fractures and along the gypsum contact. Finally, the detection of a rule of faulting, however difficult to explain, was more useful to the mine-manager than scientific ruminations concerning the source of the ore, the age of the deposits, or the paleontology of the rocks enclosing them. Both Leadville and Rico afford striking examples of the fact that in ascertaining the structural relations of ore deposits, the geologist can give the miner the most positive aid; as was early recognized by Emmons,* who, by his consistent effort to develop this line of research, was enabled to give to geology an economic function previously unknown in metal mining.

The deposition of ore in a soluble stratum by the agency of mineral solutions rising along vertical fractures is also illustrated in the Black Hills region of South Dakota, more particularly in the Bald Mountain area.¹ There the dolomite has become replaced by silicious ore containing gold and silver, evi-



NON-PERSISTENCE OF BEDS

SHOWING HOW BED OF SANDSTONE THINS TO EXTINCTION

dently introduced from 'verticals,' which are themselves also ore-bearing to a minor degree. Thus the character of the ore deposition bears a suggestive likeness to that of Rico.

In the Black Hills the ore is found at two levels, known as upper and lower 'contacts,'

* 'Structural Relations of Ore Deposits.' By S. F. Emmons. Trans. A.I.M.E. Vol. XVI. Pp. 804-839. This is one of the most useful geological papers ever written.

¹ 'Economic Resources of the Northern Black Hills.' U.S. Geological Survey. Professional Paper No. 26. By J. D. Irving and S. F. Emmons.

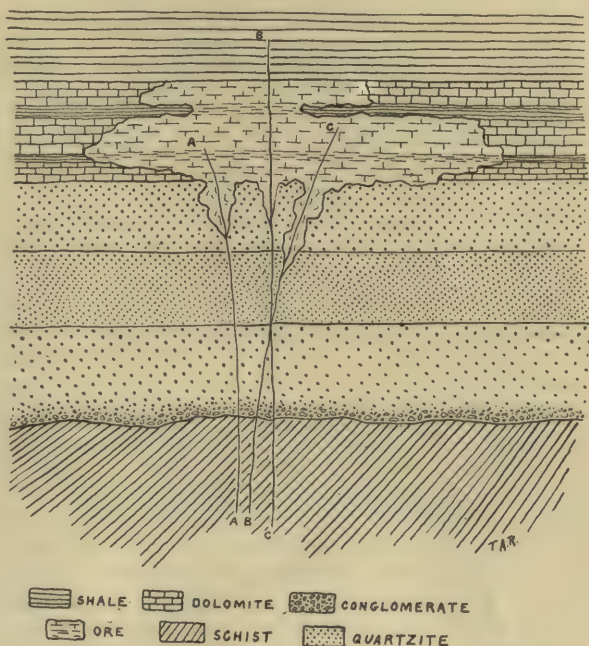
both identified with layers of dolomite, one lying near the top of the Cambrian series and the other directly upon the quartzite at the base of that formation. In both cases the dolomite containing the ore is overlain by an impermeable shale, which appears to have barred the farther ascension of the mineral solutions, compelling them to disperse laterally. The orebodies occur in flat masses roughly parallel to the stratification. They are well defined at their upper limit, against the shale, but are irregular in outline and in shape downward, where they converge into the fractures from which they derived their enrichment. The longest orebody, in the Tornado-Mogul mines, was worked for 4150 feet, for a width of 180 feet at its centre and tapering almost to a point, so as to exhibit a lenticular shape. The largest orebodies mark the convergence of a number of small orebodies, as we have seen at Rico. The thickness of the ore is less variable, since it is dependent upon the thickness of the beds that it has replaced. In the Bald Mountain area the thickness ranges from 5 to 10 feet. In the thickest masses the ore is interrupted by partings of shale, which sometimes suffice to divide the deposit into two separate blankets of ore.

The mineralization adjoining the fractures is restricted in extent. Ten feet may be given as an average. Where an orebody is wider than this, it is due to the coalescence of several parallel ore-shoots, connected with a number of adjacent fractures.

In most cases it is not difficult to discern the 'vertical' with which the orebody is genetically connected. In old stopes it will appear as a line of iron-stained quartz projecting beyond the softer country-rock. While the original 'vertical' may have been a simple crack due to rupture, it is now seen to be enlarged by silicious replacement of its walls. Some of the veins show cavities lined with crystalline quartz. If the replacement of the encasing rock has proceeded far enough, the 'vertical' will constitute a vein of ore, and is mined profitably. These fractures mark lines of movement, slight but clearly discernible. The dislocation ranges from 1 to 6 inches. In some instances the vein-fractures extend into the roof of the flat orebodies, and in every case they extend downward. In places they have been traced into the basal Algonkian rocks.

In searching for these orebodies it has been found advisable to "sink to quartzite," that is, to the base of the ore-bearing series, where the lower 'contact' is easiest found. Then levels are run at right angles to the strike of the fissure system, with supplementary cross-cuts to intersect the intervening ground. Thus an extensive area is thoroughly tested.

In this case, as at Rico and Leadville, the origin of the ore and its method of deposition are less important to the miner than the structure of the deposits, more particularly the distinct relation between the contacts and the vertical veins. Given this relation, which is a



TYPE OF SILICIOUS ORE DEPOSITS, BLACK HILLS, SOUTH DAKOTA, SHOWING REPLACEMENT OF DOLOMITE BY ORE FED THROUGH SMALL VERTICAL VEINS.

geological first-aid to mining, the search for ore is enormously simplified. The recognition of the facts was of immediate practical value, but that recognition came only as the result of observation and correlation based upon scientific reasoning. It is one thing to look and another to see; it is one thing for a miner to note a coincidence and it is another for the geologist to explain to the miner the true significance and probable cause of such a coincidence. For then comes the great test of science: the ability to foretell, the capacity to guide; the power to illuminate the dark places underground.

MONO-GUIDE SYSTEM OF HOISTING IN INCLINED SHAFTS.

By ERNEST F. AYTON.

THE labour and trouble connected with the raising of waste while sinking inclined shafts by the usual method of skips and rails induced me to adopt the plan herewith described.

The many advantages of the system were clearly demonstrated at a mine in one of the northern states of Mexico. The average dip of the vein was 73° and the shaft was sunk to a depth of 430 ft. After the sinking was finished, the arrangement was found to answer so well that the same system was continued for permanent hoisting.

When hoisting with skips, while sinking operations are in progress, a section of several yards is usually allowed, as 'play' for the stones when blasting, between the lowest limit of the timbers supporting the rails and the bottom of the shaft. This entails the placing of provisional rails to carry the skip to the bottom of the shaft or ladders to raise the waste, by manual labour, to the skip-station.

Referring to the two drawings, Fig. 1 shows the bucket at the top of the shaft or winze, the safety-door being closed. In proportion to the other details, the bucket may be made for any reasonable capacity. Cross-pieces (*E*) are placed next the hanging wall and in line with the average inclination of the shaft. They support the longitudinal sleeper (*D*) and are placed at intervals of 9 ft. or so, according to the length of the sleeper employed, so that the joint of the sleeper will correspond and can be secured to any particular one of them. (*CC*) is a flat-bottomed rail (for a 1-ton bucket, 20 lb. per yard) secured by bolts and nuts to the longitudinal sleeper (*D*). The skate (*BB'*) is made from an ordinary iron pipe having a small section cut out along its length to allow for the web of the rail. At both ends of the pipe, and fitted inside of it, is a wrought-iron shoe about 9 inches long; the inside being shaped to an easy 'sliding' fit to suit the head of the rail. The top wing (*B*) is made of a pair of plates having a space of $1\frac{1}{2}$ in. between them, and secured by bolts and ferrules. The wing is clamped on to the pipe, one of the bolts passing through the two plates, pipe, and shoe.

In the space between the plates is the pulley

(*b*), which carries the rope while the bucket is being lowered or raised when free from the skate. The pulley can be set at several points up to (*b'*), and, in combination with the adjustable hinge-arm (*G*), the bucket can be 'plumbed' from the angle of the inclined shaft.

The bottom wing (*B'*) is also made of two plates, and, like the upper one, has a space between them to receive the arm (*G*) and hinge-pin (*p*). The hinge-pin is chained to the skate. The sneck-rod (*g*) is fitted to the face of the skate. The safety-sneck (*F*) prevents the capsizing of the bucket in case the skate may meet some obstruction while going down the shaft. The door (*H*), when open, answers the purpose of a fence to the mouth of the shaft. Attached to the centre of the door is a 'kep' (*k*) firmly supported by diagonals.

After the full bucket arrives at the top of shaft, the door is closed, and, when slack rope is given, the kep stops the downward progress of the skate and at the same time releases the sneck; the bucket then starts to tipple over and finally reaches the position shown by dotted lines.

Fig. 2 represents the released bucket arriving at the bottom of the shaft. Before the skate reaches the check block, the pin (*p*) is drawn out by the rapper-boy and the bucket continues its progress, without stopping, to the shaft bottom. The flanged tube (*h*), resting on the socket of the rope, is cut to a length so that when it reaches the top wing (*B*), the eye of the hinge-arm (*G*) and those of the fulcrum wing (*B'*) are in position to receive the hinge-pin (*p*). In many instances the pin is placed without stopping the rising bucket.

The following advantages will also be apparent to those who have had anything to do with diagonal shaft-work: rapidity of working, freedom from interruptions caused by obstructions on the rails. When applied to drainage purposes, the bucket can be dropped into the water while the mono-guides can be placed in position many feet above it. There is no trouble due to 'floating' skips.

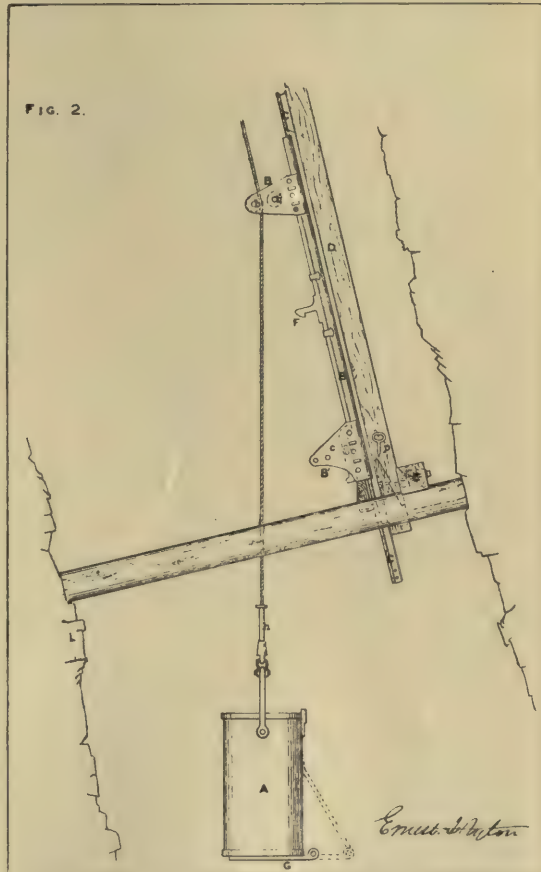
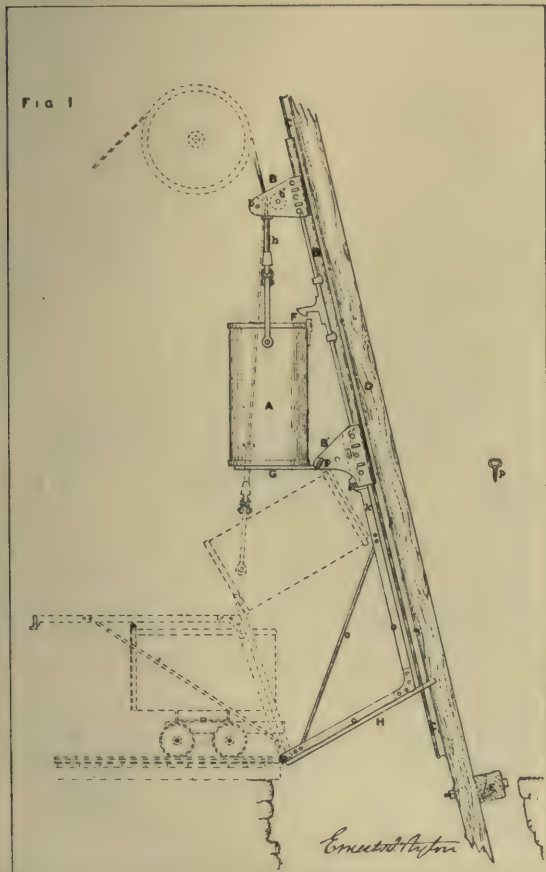
The system can be applied to any angle from a few degrees to 35° from the vertical.

Finally, there are no patents in connection

with the apparatus and anyone is at liberty to make free use of the idea. I may add that the mono-guide system has received the highest endorsements of several engineers who have seen it in actual operation.

The Museum of Practical Geology owes its origin to a representation submitted to the Government, in 1835, by Sir Henry De la Beche, the founder of the Geological

the mineral resources of the British Isles. In 1837, Lord Duncannon, then Chief Commissioner of Woods and Forests, allotted apartments for this purpose at No. 6 Craig's Court, Charing Cross; and thus was founded what was then termed 'The Museum of Economic Geology.' An institution so practical in character and so peculiarly adapted to the wants of a great commercial and manufacturing community at once attracted the sympathy of



Survey of the United Kingdom. During the progress of the Survey, which had been commenced a few years previously in the south-west of England, the officers had obtained specimens of minerals, rocks, and fossils, which it was clearly desirable to preserve. It was suggested by De la Beche that these specimens would form an excellent nucleus of a museum of a special character, designed partly to illustrate the work of the Survey and partly to show the application of geology to the useful purposes of life, and especially to exhibit

those engaged in our mining and metallurgical industries. Contributions of appropriate specimens were thus readily secured, and so rapid was the growth of the collections that, in the course of a few years, it became necessary to secure ampler accommodation. Eventually the Government authorized the erection, after plans by Mr. James Pennethorne, of the present building, which is situated between Piccadilly and Jermyn Street, and is officially designated 'The Museum of Practical Geology.' On May 12, 1851, the Museum was opened.

QUOTATIONS

of leading mining shares on the London Market.
Shares are £1 par value except where otherwise noted.
Quotations are given in shillings.

| | Aug. 1 1913 | July 1 1914 | July 30* 1914 |
|--------------------------------------|----------------|----------------|------------------|
| GOLD, SILVER, DIAMONDS: | | | |
| RAND: | | | |
| Bantjes..... | 16 | 14 | 11 |
| Brakpan..... | 66 | 51 | 42 |
| Central Mining (£12)..... | 180 | 160 | 120 |
| Cinderella..... | 7 | 6 | 5 |
| City & Suburban (£4)..... | 42 | 52 | 42 |
| City Deep..... | 53 | 66 | 52 |
| Consolidated Gold Fields..... | 46 | 43 | 36 |
| Consolidated Langlaagte..... | 25 | 35 | 30 |
| Consolidated Main Reef..... | 17 | 18 | 16 |
| Crown Mines (10s.)..... | 133 | 120 | 107 |
| Durban Roodoport..... | 16 | 21 | 20 |
| D. Roodoport Deep..... | 20 | 17 | 17 |
| East Rand Proprietary..... | 47 | 33 | 30 |
| Ferreira Deep..... | 57 | 47 | 40 |
| Geduld..... | 20 | 23 | 20 |
| Geldenhuis Deep..... | 30 | 26 | 21 |
| Heriot..... | 57 | 55 | 55 |
| Jupiter..... | 6 | 5 | 4 |
| Kleinfontein..... | 18 | 24 | 18 |
| Knight Central..... | 8 | 11 | 5 |
| Knight's Deep..... | 40 | 35 | 30 |
| Langlaagte Estates..... | 22 | 20 | 17 |
| Luipaard's Vlei..... | 8 | 10 | 10 |
| Main Reef West..... | 10 | 7 | 7 |
| Meyer & Charlton..... | 102 | 115 | 95 |
| Modderfontein B..... | 77 | 89 | 72 |
| Modderfontein, New (£4)..... | 237 | 263 | 220 |
| Nourse..... | 30 | 27 | 25 |
| Primrose..... | 33 | 21 | 17 |
| Rand Mines (5s.)..... | 126 | 120 | 95 |
| Randfontein Central..... | 27 | 17 | 13 |
| Robinson (£5)..... | 60 | 57 | 52 |
| Robinson Deep..... | 33 | 33 | 20 |
| Rose Deep..... | 57 | 43 | 37 |
| Simmer & Jack..... | 12 | 12 | 9 |
| Simmer Deep..... | 2 | 1 | 1 |
| Springs..... | 16 | 11 | 10 |
| Van Ryn..... | 66 | 67 | 50 |
| Van Ryn Deep..... | 30 | 47 | 38 |
| Village Deep..... | 38 | 40 | 36 |
| Village Main Reef..... | 41 | 40 | 35 |
| Witwatersrand (Knight's)..... | 67 | 71 | 57 |
| Witwatersrand Deep..... | 53 | 48 | 40 |
| Woluter..... | 14 | 14 | 10 |
| RHODESIA: | | | |
| Cam & Motor..... | 27 | 19 | 16 |
| Chartered..... | 18 | 17 | 13 |
| Eileen Alannah..... | 10 | 11 | 8 |
| Eldorado..... | 13 | 18 | 11 |
| Enterprise..... | 9 | 9 | 7 |
| Falcon..... | 15 | 14 | 12 |
| Giant..... | 10 | 14 | 10 |
| Globe & Phoenix (5s.)..... | 27 | 32 | 26 |
| Lonely Reef..... | 49 | 27 | 23 |
| Shamva..... | 38 | 46 | 37 |
| Wanderer (5s.)..... | 2 | 3 | 2 |
| Willoughby's (10s.)..... | 7 | 7 | 7 |
| OTHERS IN SOUTH AFRICA: | | | |
| De Beers (£2 10s.)..... | 413 | 330 | 270 |
| Glynn's Lydenburg..... | 15 | 11 | 11 |
| Jagersfontein..... | 130 | 78 | 65 |
| Premier Diamond (2s. 6d.)..... | 231 | 152 | 120 |
| Sheba (5s.)..... | 5 | 4 | 4 |
| Transvaal Gold Mining Estates..... | 52 | 37 | 37 |
| WEST AFRICA: | | | |
| Abbontiakoon (10s.)..... | 6 | 8 | 7 |
| Abosso..... | 15 | 14 | 11 |
| Asbanti (4s.)..... | 19 | 16 | 13 |
| Broomassie (10s.)..... | 6 | 2 | 2 |
| Prestea Block A..... | 13 | 15 | 11 |
| Taquah..... | 15 | 15 | 13 |
| WEST AUSTRALIA: | | | |
| Associated Gold Mines..... | 7 | 7 | 5 |
| Associated Northern Blocks..... | 17 | 6 | 6 |
| Bullfinch..... | 53 | 43 | 42 |
| Golden Horse Shoe (£5)..... | 13 | 14 | 12 |
| Great Boulder Proprietary (2s.)..... | 2 | 2 | 2 |
| Great Boulder Perseverance..... | 8 | 9 | 7 |
| Great Fingall..... | 57 | 50 | 43 |
| Ivanhoe (£5)..... | 37 | 36 | 35 |
| Kalgurli..... | 20 | 23 | 21 |
| Sons of Gwalia..... | 8 | 3 | 2 |
| Yuanmi..... | | | |
| OTHERS IN AUSTRALASIA: | | | |
| Blackwater..... | 20 | 16 | 16 |
| Consolidated Gold Fields of N.Z..... | 12 | 13 | 13 |
| Mount Boppy..... | 15 | 10 | 10 |
| Mount Morgan..... | 70 | 52 | 45 |
| Progress..... | 8 | 10 | 10 |
| Talisman..... | 40 | 33 | 30 |
| Tasmania Gold (10s.)..... | 1 | 3 | 3 |
| Walbi..... | 45 | 42 | 30 |
| Waihi Grand Junction..... | 22 | 25 | 23 |
| AMERICA: | | | |
| Alaska Treadwell (£5)..... | 160 | 162 | 160 |
| Buena Tierra..... | 17 | 15 | 16 |
| Butters Salvador..... | 40 | 20 | 20 |
| Camp Bird..... | 15 | 9 | 7 |
| Canadian Mining..... | 52 | 13 | 10 |
| Casey Cobalt..... | 14 | 14 | 13 |
| El Oro..... | 21 | 15 | 11 |
| Esperanza..... | 11 | 10 | 8 |
| Granville..... | 11 | 74 | 57 |
| Kirkland Lake Proprietary..... | 105 | 97 | 95 |
| Mexico Mines of El Oro..... | 5 | 10 | 10 |
| Oroville Dredging..... | 16 | 15 | 14 |
| St. John del Rey..... | 16 | 11 | 10 |
| Santa Gertrudis..... | 26 | 22 | 18 |
| Tomboy..... | — | 28 | 17 |
| Tough-Oakes..... | — | 28 | 17 |
| RUSSIA: | | | |
| Lena Goldfields..... | 52 | 43 | 30 |
| Orsk Priority..... | 15 | 7 | 5 |
| Siberian Proprietary..... | 3 | 3 | 3 |
| INDIA: | | | |
| Champion Reef (2s. 6d.)..... | 102 | 11 | 10 |
| Mysore (10s.)..... | 10 | 93 | 80 |
| Nundhydroog (10s.)..... | 25 | 27 | 23 |
| Ooregum (10s.)..... | 19 | 23 | 21 |
| COPPER: | | | |
| Anaconda (£5)..... | 146 | 126 | 100 |
| Arizona (5s.)..... | 38 | 36 | 32 |
| Cape Copper (£2)..... | 110 | 60 | 55 |
| Chillagoe (10s.)..... | 1 | 1 | 1 |
| Cordoba (5s.)..... | 7 | 6 | 5 |
| Great Cohar (£5)..... | 48 | 3 | 2 |
| Great Fitzroy (5s.)..... | 1 | 3 | 3 |
| Hampton Cloncurry..... | 42 | 27 | 23 |
| Kyshtim..... | 58 | 55 | 37 |
| Messina (5s.)..... | 27 | 15 | 12 |
| Mount Elliott (£5)..... | 100 | 55 | 51 |
| Mount Lyell..... | 24 | 23 | 20 |
| Rio Tinto (£5)..... | 1497 | 1355 | 1060 |
| Sissert..... | 18 | 25 | 20 |
| South American Copper (2s.)..... | 34 | 22 | 15 |
| Spassky..... | 66 | 52 | 35 |
| Tanayik..... | 52 | 78 | 45 |
| Tanganyika..... | 46 | 40 | 30 |
| Tharsis (£2)..... | 140 | 125 | 110 |
| Whim Well..... | 13 | 11 | 1 |
| LEAD-ZINC: | | | |
| BROKEN HILL: | | | |
| Amalgamated Zinc..... | 31 | 28 | 25 |
| British Broken Hill..... | 39 | 36 | 29 |
| Broken Hill Proprietary (8s.)..... | 35 | 36 | 29 |
| Broken Hill Block 10 (£10)..... | 28 | 32 | 26 |
| Broken Hill Block 14 (25s.)..... | 6 | 6 | 5 |
| Broken Hill North..... | 48 | 52 | 45 |
| Broken Hill South..... | 152 | 175 | 155 |
| Sulphide Corporation (15s.)..... | 25 | 26 | 22 |
| Zinc Corporation (10s.)..... | 17 | 19 | 16 |
| ASIA: | | | |
| Burma Corporation..... | — | 28 | 26 |
| Russian Mining..... | 8 | 31 | 15 |
| Russo-Asiatic..... | — | 151 | 90 |
| TIN: | | | |
| NIGERIA: | | | |
| Bisichi..... | 20 | 8 | 7 |
| Jos (5s.)..... | 7 | 5 | 5 |
| Kaduna (5s.)..... | 20 | 15 | 15 |
| Naraguta..... | 34 | 17 | 17 |
| N. Nigeria Bauchi (10s.)..... | 4 | 3 | 2 |
| Rayfield..... | 20 | 5 | 5 |
| Ropp..... | 137 | 100 | 95 |
| OTHER COUNTRIES: | | | |
| Aramayo Francke..... | 32 | 31 | 31 |
| Brisels..... | 11 | 5 | 5 |
| Cornwall Tailings..... | 22 | 17 | 15 |
| Dolcoath..... | 17 | 11 | 9 |
| Geveor (10s.)..... | 16 | 5 | 5 |
| Gopeng..... | 31 | 27 | 27 |
| Mawchi..... | 18 | 20 | 12 |
| Pahang Consolidated (5s.)..... | 9 | 7 | 8 |
| Renong Dredging..... | 27 | 36 | 30 |
| Tekka..... | 60 | 55 | 55 |
| Tronoh..... | 57 | 26 | 26 |

* The Stock Exchange was closed from July 30 onward; the quotations on that day were nominal.

PRECIS OF TECHNOLOGY

Geology of Northern Shan States.—In the 'Indian Geological Terminology,' by Sir Thomas Holland and G. H. Tipper, just issued by the Geological Survey of India, there appears a map of the Northern Shan States and an account of the stratigraphy. Owing to the interest now taken in this part of the world, following the developments done by the Burma Corporation, particulars of which were given in this column in the June issue, we reproduce the map herewith, with some notes of the general geology. The oldest rocks are the granites, gneisses, and schists in the northwest. Mogok is in a gneissic area.¹ Then comes the Twang-peng system, belonging to the Cambrian age, and divided

with strong lenticular bands of coarsely crystalline limestone, all containing fossils. There is great variation in the lithological character of the rocks at different localities. Later than the Naungkangyi come the Namhsin beds which are found in the gorge of the river of that name. These consist of sandstones, a thin band of marly beds with hard limestones, and marls. The fossils correspond to those of the Wenlock beds belonging to the Silurian age.

The Plateau Limestone forms the plateau country, and has a considerable extension southward. The prevailing type is a whitish or light-grey rock, weathering to a darker tint and stained by oxide. It becomes arenaceous near its boundary with the older rocks. The composition varies from a pure calcite, through



GEOLOGY OF THE NORTHERN SHAN STATES.

into (1) the Mica Schists of Mong Long, (2) the Chaungmagyi series, and (3) the Bawdwin Volcanic series, the first named being the lowest of the system. The Chaungmagyi consists of a series of unfossiliferous red, purple, and grey quartzites, slaty shales, and felspathic grits, generally showing signs of alteration. The rocks have suffered deformation and denudation before the deposition upon them of beds belonging to the Ordovician age. The Bawdwin series consists of rhyolitic flows and tuffs, and are extensively mineralized in the neighbourhood of Bawdwin. Above the Twang-peng system come the Naungkangyi beds, which belong to the Ordovician age. They are divided into two stages, Upper and Lower. The Upper has a much wider distribution on the surface than the Lower, and consist of argillaceous shales and claystones, often resembling lithomarge in texture, and of every variety of colour. In all cases they show evidence of intense crushing, resulting in a general distortion of the fossils. Two lithological varieties can be distinguished, one composing all the beds of the variegated type of Lashio, and the other, the predominating type in the eastern range, consisting mainly of purple claystones. The Lower stage consists of yellow or buff sandy marls

dolomitic limestones, to almost true dolomites. The dolomitization is more complete in the unfossiliferous massive limestones. Brecciated dolomites re-cemented by calcite are not uncommon. Oolitic dolomites also occur. The system may be divided into two sections, the Lower belonging to Devonian age and the Upper to the Anthracolithic or Carboniferous-Permian. The Lower includes also the Wetwin shales, which are highly argillaceous, and of yellowish-buff colour.

The Napeng beds are found in patches in various places, and correspond to the Rhætic beds of the Trias. They consist principally of yellow or variegated, highly argillaceous shales, or indurated clays. Occasionally they are impregnated with calcareous matter and pass into sandy marls or tough argillaceous thin-bedded limestones. Tertiary deposits are found northeast and southeast of Lashio, and alluvium exists west of Mandalay. No mention is made by the authors of the Banyan beds, overlying the Bawdwin beds at the mine of the Burma Corporation. These are described in the Corporation's report as consisting of quartzite, shale, and sandstone, and they presumably belong to the Naungkangyi system. A section of these rocks was given in our June issue.

Graphite-coated Diamonds.—At the March meeting of the Geological Society of South Africa, P. A. Wagner described four small diamonds, recently found at the Premier mine, that are coated with a thin film of graphite. The largest weighs less than half a carat, and is in the form of a combination of a trisoctahedron, rhombic dodecahedron, and octahedron, the dodecahedral faces being distinctly striated parallel to the octahedral edges. As one corner of the stone has been broken off, it is possible to see that the stone itself is of brown colour. The coating of graphite is opaque, and is approximately 0.02 millimetre thick. It is built of minute plates and scales measuring up to 0.2 mm. diameter. It is dark blackish grey in colour, has a bright metallic lustre, and readily marks paper. Mr. Wagner has no theory as to the method or cause of formation of this graphite, and reluctantly adds the phenomenon to the already formidable list of unsolved problems in connection with South African kimberlite deposits. The conditions under which the graphite occurs on the diamonds suggest that it might be of secondary origin. Transformation of the diamond into graphite, as is well known, can be effected at the temperature of the electric arc, but it is difficult to believe that diamonds could have been raised to this temperature subsequently to their formation. Another possible explanation is that the graphite was formed on the relief of pressure, either before the growth of the diamond crystals had actually ceased, or at a time when the newly formed diamonds were still at a comparatively high temperature. On either supposition, however, it is impossible to imagine that the alteration should take place in so small a proportion of the diamonds found. An explanation therefore is still required.

Malayan Geology.—In our issues of May and June 1913, we referred to the report by J. B. Scrivenor on the geology of the Kinta district of Perak, in which the author shows that the tin-bearing clays are not of recent alluvial origin but are glacial clays of the Gondwana series belonging to Permo-Carboniferous age. He showed also that the granite hills on both sides of the Kinta valley are of Mesozoic age, later than the tin-bearing clays, so that the cassiterite could not come from this source but from some earlier granite of unknown locality. In the *Geological Magazine* for July, Mr. Scrivenor gives additional evidence as to the relative age of the Gondwana clays and the Mesozoic granite, and he describes by the aid of photographs two new sections of the junction between the clays and the granite.

The two sections occur on the east side of the Kinta valley, one on the land worked by the Tekka company, the other on the land worked by the Société des Etains de Tekka. Both these mines lie to the north of Gopeng.

On the Tekka company's land the Gondwana clay near the granite is of a deep-red colour. Boulders of considerable size are rare in the clay, in fact the only big boulders seen in situ are those of corundum, described in Mr. Scrivenor's report. Lately, however, he has seen some good sections with small boulders bearing a striking resemblance to boulder-clay. At one part of the mine, newly opened up, the clays can be followed for a distance of about 80 yards right up to a well-exposed junction with the granite, which is here soft owing to its being rich in kaolinite and also to the effect of weathering. Perhaps the kaolinite was partly formed by weathering. At a distance of about 30 ft. from the junction the clay shows no sign of alteration, but within that distance coloured streaks appear, that might in some places be described as folia, and increase as the granite is approached, until at the junction the clay, instead of being a uniform

deep-red colour, it is a roughly foliated and banded mass of red, black, white, and yellow streaks, and is traversed by small, hard veins of blue tourmaline, which are not easily observable until the clay is broken up. The black streaks were found to contain iron and manganese. Mineral matter heavier than sp. gr. 2.8 separated from the altered clay in bulk was found to be chiefly blue tourmaline, but comprised a few grains believed to be secondary corundum and hercynite. Near this section the clay is traversed by white veins which are fairly hard and fine-grained. Some are as much as 6 in. thick, but the majority are smaller than that. Sections and separations show them to consist of white mica and fluorite as a fine mosaic of irregular flakes and grains, with minute grains and acicular particles of corundum that form veinlets in the mosaic, and a small quantity of another mineral believed to be a spinel. The corundum in these veins must not be confounded with the corundum boulders. It was clearly brought into being by the influence of the granite, whereas the big corundum boulders are detrital components of the clay. The granite junction is irregular and, apart from the evidence of alteration, leaves no doubt that the granite was intruded into the clay.

The section on the Société des Etains de Tekka is even clearer than that just described. In the mine a large intrusive mass of granite with tourmaline veins has been disclosed. On either side, as seen now in section, it falls away at an angle of about 45°, and is in part fairly hard. On the north side of the granite a big face of clay has been exposed for some time, extending from the granite junction about 100 ft. At about 80 ft. from the granite pebbly beds are exposed. One of them passes downwards vertically into clay, the pebbles becoming fewer and fewer. From the pebbly beds, which are grey, to the granite the whole section is of deep-red clay with very little stone. At the junction shown in the photograph, as clean a junction between two rocks as one can hope to see, the streakiness observed in the Tekka company's section is not so extensively developed, but is visible both in the vertical section and in the floor of the mine, where the junction can also be followed. No tourmaline or fluorite and mica veins were seen, but in a section in another mine nearby a vein of blue tourmaline was traced for 40 ft. from the granite into the clay. On the south side of the granite the clay has been largely worked away, but an interesting point is that here one of the kaolin veins described by the author elsewhere as traversing the clays was seen traversing the granite. These veins are of almost pure kaolinite, without any proved felspar.

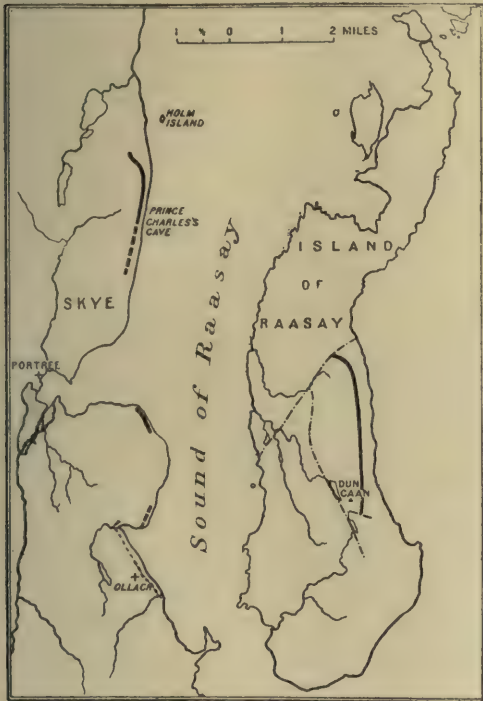
To anyone unacquainted with the effects of tropical weathering a surprising feature of the clay in both these sections at the granite junction would be that it is soft enough to be cut by hand. Shales, and some rocks harder than shales, generally weather to the consistency of cheese in the Malay States, but in every section seen by Mr. Scrivenor the bedding is preserved up to the subsoil. At a granite junction, however, where the latter is clearly intrusive, one would expect some degree of greater hardness. In the case of shales and other rocks this is found, and the lack of it in these clays is, the author thinks, ascribable to two causes. In the first place the clays, although they contain a certain amount of grit, are everywhere rich in kaolinite, and therefore it may be assumed that when the granite was intruded they were very plastic and yielded easily to the pressure of the earth-movements. This would result in the generation of a relatively small amount of heat compared with less

plastic rocks, and consequently less alteration. Secondly, supposing silicification had been set up, resulting in an indurated clay, the evidence of the effect of ground-water on the large outcrops of quartzite in the country shows that in the present position of the clays the silicious cement would certainly have been removed by now.

Oil in Skye.—In several issues during the past year we have made short reference to the occurrence of oil-shale in the Island of Skye, off the northwest coast of Scotland. The 'Summary of Progress for 1913,' published by the Geological Survey of Great Britain, contains an account of this deposit. The stratigraphical position of the shale is at the base of the Great Estuarine Series of the Oolite and immediately above

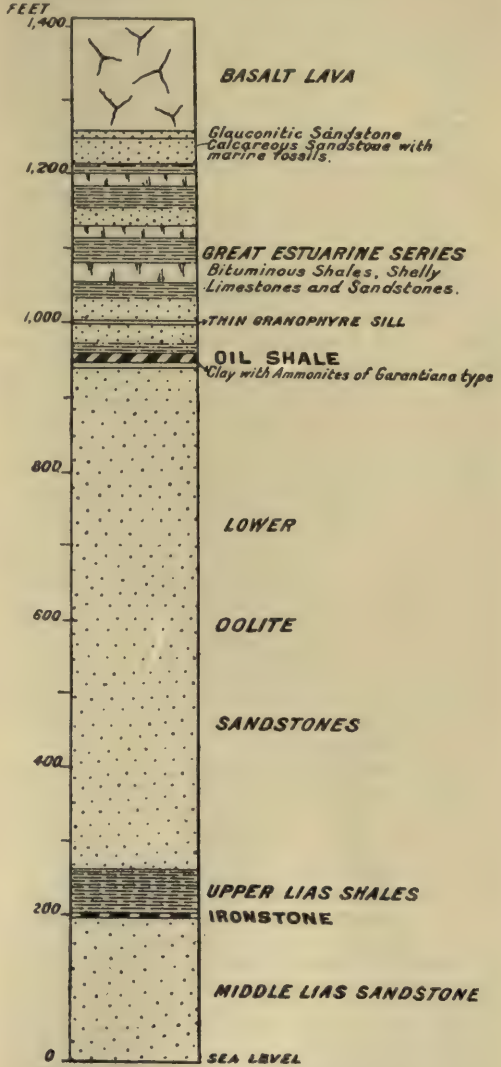
monia. A compound sample from the Skye coast, between Holm island and Prince Charles's cave, yielded 12·8 gal. crude oil per ton and 7·4 lb. sulphate of ammonia. To obtain so much from weathered shale is highly encouraging.

Before the period of denudation that removed so



Oil Shale. [igneous rocks.
Oil Shale, where burnt by contact action of
Faults.
OILCROPS OF OIL-SHALE IN SKYE AND RAASAY.

a marine clay belonging to the Lower Oolite. The shale is brownish, with a brown streak, fine-grained, and gives a wooden sound when struck by the hammer. It is tough and resists disintegration by weathering, a characteristic that distinguishes it from the bituminous shales found throughout the Estuarine Series, all of which crumble into small fragments. The weathered surface assumes a lilac or a yellowish coating. The thickness of the seam at the outcrop is from 7 to 10 ft., and its passage into the overlying sediments is gradual. The samples so far analysed have all come from the weathered outcrops, and no exact information has been obtained as regards the oil and other products extractable from the fresh shale. A sample from the outcrop where the shale was first detected in Raasay gave 12 gallons of crude oil per ton of shale, together with 6·2 lb. of sulphate of am-



SECTION OF JURASSIC ROCKS BELOW DUN CAAN.

much of the Scottish Jurassic rocks, the shale probably extended over a large area. Considerable portions have escaped denudation. In the island of Raasay, the area stretches from Dun Caan northward to the boundary fault (see the accompanying map) that throws the Mesozoic rocks against the Torridonian division of the pre-Cambrian. The district is 3 miles long, and averages nearly a mile wide, diminishing to the south. The strata are not folded, and they dip at 10° to the west.

In the Portree district of Skye there was at one time extensive beds of shale, of which much has been destroyed by the action of intrusive rocks. The out-

crop has been traced from Ollach, 5 miles south of Portree, to Holm Burn, 5 miles north of Portree. The outcrop south of Portree shows much alteration from heat; to the north, part of the outcrop is altered, but toward Holm Burn this effect is not observable. The extent of the shale beds westward cannot be ascertained, as they are covered with other beds and there is no other exposure. As the dip is low, the beds should be workable for a considerable distance. Farther north than Holm Burn the shale changes into sandstone. In the peninsula of Strathaird, the shale outcrop is entirely destroyed by the action of igneous intrusions.

Callow's Flotation Process.—In the *Engineering and Mining Journal* for June 27, Ernest Gayford describes the concentrator at the National copper mine in the Cœur D'Alene district, Idaho. This installation is of interest, as it includes a flotation plant designed by J. M. Callow, of Salt Lake City, for the treatment of minus 60-mesh material after the ore has been passed over tables. The ore contains over 90% silica and 7½% of iron-copper sulphides. The fine material, after dewatering, is diluted with water from the flotation circuit to 4½ : 1, and delivered to mixing-tanks, of construction similar to a Pachuca vat. Oil is here added to the pulp, which is agitated by the air-lift. The oiled pulp is sent to primary flotation cells each 25 in. wide by 8 ft. 9 in. long, divided into 8 compartments, with a bottom inclined at 3 in. to the foot. A froth is caused by compressed air admitted into each compartment through four thicknesses of heavy canvas. The sulphide mineral raised in the froth passes over the edge into a launder, and is sent to a secondary cell for the production of clean concentrate. The consumption of oil is from 0.2 to 0.3 lb. per ton of solid. The feed averages 0.8% copper, the concentrate 16%, and the tailing 0.17%. The plant consists of two units, each with a capacity of 250 tons per 24 hours. Each unit consists of one Pachuca, four primary cells, and one finishing cell. The total power required for air compression for the whole plant is 30 horse-power.

Diffusion of Metals in Nature.—In the issue of *Economic Geology*, Vol. IX. No. 1, R. A. F. Penrose draws attention to the fact that, though the alteration of the upper parts of orebodies by chemical agencies has been the cause of formation of enrichments, enormous amounts of metal must have been distributed in unprofitable form by the same action. The enrichments are, of course, of great importance from an economic standpoint, and full of interest from a purely geological and chemical standpoint, so that they attract attention to the almost total disregard of the vast diffusion of leached metalliferous materials that usually accompanies this concentration. The amount concentrated is usually small compared with the amount diffused, while often little or none has been concentrated and practically all the metalliferous materials leached from above have been diffused.

In some ore deposits the upper parts as they exist today can be seen to have been leached more or less completely of certain metalliferous materials for depths of from several hundred to a thousand feet or more, and yet often only a small part of these materials can be accounted for in what is found below, either in the form of oxidized products, sulphide enrichment, or other substances resulting from superficial alteration. Moreover, erosion in many cases has for long ages been gradually carrying away the leached outcrops as they were formed, removing hundreds or even thousands of feet from the upper parts of ore deposits, so that enormous amounts of metalliferous materials may

have been taken into solution from outcrops that no longer exist; and yet these materials are not found re-deposited below in quantities commensurate with what must have been leached from above. Hence they must have gone somewhere else, or in other words, must have been diffused, instead of being accumulated in the ore deposit.

As the exposed parts of an ore deposit are gradually eroded, superficial alteration constantly encroaches below on parts that may have been previously enriched by re-deposition, and these parts may themselves in turn be subjected to leaching, just as once the parts above them were leached; and the metalliferous materials may be again taken into solution, to be again partly diffused and partly re-deposited below in the ore deposit. This process may be repeated over and over again as erosion progresses, and hence there is a natural check to accumulation, while diffusion continues freely, so that the ratio of the total amount of material diffused to the total amount accumulated at any one time constantly increases. Thus there is a reason why the amount diffused is often so vastly greater than the amount found re-deposited below.

The factors that determine the relative amounts of diffusion and accumulation by solution in the superficial alteration of ore deposits are the chemical and physical nature of the deposits and of the enclosing rocks, the topography, the climate, and the various other local conditions. If an ore deposit is sufficiently porous or fissured to allow the solutions to pass down into it, and yet has wall-rocks sufficiently impervious and free from fissures to prevent the solutions from being readily deflected to outside areas, a concentration and consequent enrichment may occur if suitable precipitating agents exist. Where, however, the wall-rocks are porous or intersected by fissures, the solutions may pass out of the deposit and be lost in the drainage of the region, or may lay down their metalliferous contents in a more or less disseminated form in the enclosing rocks. In either case there is a diffusion of metalliferous material. This may be increased if the ore deposit is of an impervious character that impedes downward percolation and thus encourages lateral migration of the solutions, or if precipitating agents are absent, so that the solutions pass through the ore deposit without laying down their metalliferous contents, or under various other conditions.

Thus it is seen that the relative amounts of diffusion and concentration of leached materials vary greatly under different conditions, and in nature all stages are found from diffusion with no concentration to diffusion with very extensive concentration. In some deposits the leached outcrop comes into direct contact with the original unaltered ore, with apparently no intervening zone of oxidized materials, native metals, enriched sulphides, or other products of superficial alteration; and here the materials from the outcrop have been altogether diffused. In other deposits small quantities of re-deposited metalliferous materials lie between the altered and the unaltered parts, or permeate the latter in films or streaks, representing slight concentration and enrichment; while elsewhere the quantities may increase to bodies of enriched ore of notable proportions, which sometimes grow to be the great bonanzas of the miner; but in most cases the total amount of diffusion has probably far exceeded the total amount of concentration.

Diffusion in an ore deposit does not always represent impoverishment from a commercial standpoint, for the metalliferous materials dissolved and carried out of the original deposit may be reprecipitated in the wall-

rocks adjoining the deposit, forming a new ore deposit, perhaps of lower grade than the original one but often of much wider extent. This is especially true where materials in the enclosing rocks are readily replaceable by materials in solution, or where the porous or fissured character of the rocks offers spaces for deposition by other processes of precipitation. Where, however, diffusion has carried the metalliferous materials out of the original deposit through the neighbouring rocks and into the general drainage of the country, they are lost so far as the locality in question is concerned, though in some far off spot they may sooner or later again be brought together.

The features of diffusion or of concentration in solution are seen in deposits of most metals, but are more common with some metals than others. In copper and iron deposits they are often notably prominent and frequently of great commercial importance. In some gold deposits marked diffusion and concentration also occur, but as a rule the gold has migrated to less distances in depth and laterally than copper and iron, while in many deposits the gold seems to have been almost untouched by superficial agencies. In silver, lead, zinc, nickel, tin, and many other metalliferous deposits, the effects of diffusion or concentration are noticeable, but vary greatly according to the mineralogical character of the deposits and the local conditions.

Thus it is seen that with some metals the migration in solution progresses rapidly and moves far, while with others it progresses slowly and moves only short distances, the difference depending on the chemical affinities of the metals in question under the conditions surrounding them. In deposits containing two or more metals, therefore, the relative amounts of diffusion or concentration may vary greatly. In some cases all the metals are affected by diffusion and concentration, though in different degrees, while in other cases none of them are appreciably affected; or one metal may be left practically unchanged in the outcrop; or one may be totally diffused and another partly concentrated below; while many other combinations may also occur.

CURRENT LITERATURE

Gold Dredging.—In the *Mining and Scientific Press* for June 27, W. H. Gardner and W. M. Shepard describe the No. 14 dredge of the Yuba Consolidated, working in California. This is the largest electrically-operated dredge in the world.

Franz Concentrator.—The *Engineering and Mining Journal* for June 27 describes the Franz concentrating table, made at Wallace, Idaho.

Classification at Miami.—The *Mining and Scientific Press* for June 27 contains an article describing the application of the Deister baffle cone classifier at the Miami copper mine, Arizona.

Stanley Classifier.—The May issue of the *Journal of the Chemical, Metallurgical, and Mining Society of South Africa* contains a paper by G. H. Stanley detailing his experiments in connection with hydraulic classifiers, and describing the machine devised by him. We referred to this machine in our issue of February 1912.

Tin-Dressing in Tasmania.—In the *Mining and Scientific Press* for July 11, J. B. Lewis describes the method of tin-dressing at the Anchor mine, Tasmania. This mine belongs to an English company and the ore is the lowest-grade of any taken from a lode mine. Unfortunately the low price of tin has caused a stoppage of operations.

Flotation Tests at Mount Morgan.—In the *Mining and Scientific Press* for June 27, William Motherwell describes the tests made by the Minerals Separation company on the silicious ore at Mount Morgan containing copper and gold in the pyrite and gold in the silica.

Converter Practice.—The June *Bulletin* of the American Institute of Mining Engineers contains a paper by Herbert Haas discussing the extension of the use of converters to raw ore and concentrate.

Converter Practice at Tooele.—The July *Bulletin* of the American Institute of Mining Engineers contains a paper by O. M. Kuchs describing the method of treating copper-lead matte adopted at the Tooele lead smelter, Utah.

Hydro-metallurgy of Copper.—The July *Bulletin* of the American Institute of Mining Engineers contains a paper by Frederick Laist and F. F. Frick on methods of precipitation of copper from solutions obtained by leaching copper ores.

Nodulizing Flue-Dust.—In the July *Bulletin* of the American Institute of Mining Engineers, Lawrence Addicks describes the method of nodulizing flue-dust from copper blast-furnaces employed at the Chrome, N.J., refinery of the United States Metals Refining company.

Arizona Copper.—In the *Engineering and Mining Journal* for June 27 and July 4, Richard H. Vail describes the new smelting plant of the Arizona Copper Company. In the July *Bulletin* of the American Institute of Mining Engineers, E. H. Jones gives a detailed statement of the costs of erecting this plant.

Zinc Smelting in Oklahoma.—In the *Mining and Scientific Press* for July 11, E. H. Leslie describes the zinc-smelting industry at Bartlesville, Oklahoma. This is the first of a series of six articles describing modern practice in zinc-smelting in the United States.

Gold Refining.—In *Metallurgical and Chemical Engineering* for July, H. Lacroix describes the working of the Dietzel electrolytic process for refining gold and other precious metals at the Geneva refinery.

Korean Mines.—The *Mining and Scientific Press* for July 18 publishes the geological report made by D. F. Higgins on the 'Collbran Contact,' belonging to the Suan Mining Co.

Einaleigh Copper.—In the *Queensland Government Mining Journal* for June, Lionel C. Ball, Assistant State Geologist, describes the ore deposit at the Einaleigh copper mine.

Leadville Ore Deposits.—In the *Mining and Scientific Press* for July 11, Philip Argall describes the occurrence of siderite with sulphides at Leadville, and makes comparison with similar deposits in other parts of the world.

Petroleum Anticlines.—The first issue of the *Journal of the Institution of Petroleum Technologists* contains a paper by Sir T. H. Holland entitled: 'Some Geometrical Features of the Anticline.'

Chilean Nitrate.—In the *Mining and Scientific Press* for June 13, 20, 27, Lester W. Strauss describes the present position of the Chilean nitrate industry.

Hydro-electric Power-plant at Homestake.—In the *Mining and Engineering World* for July 4, Richard Blackstone describes the hydro-electric plant built for the Homestake gold mine, Dakota.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

Memorials of Henry Forbes Julian. By Hester Julian. Cloth, octavo, 310 pages, illustrated. London: Charles Griffin & Co. Price 6s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This volume does not suggest criticism, only appreciation. It is the tribute of a capable woman to a useful man, of a true wife to a good husband. To those who knew H. F. Julian, the book will be deeply interesting; as a human document it reflects the lights and shadows of a professional career involving varied knowledge and world-wide travel. Wanderings in Mexico and South Africa are punctuated by restful days in Devonshire; the eager technology of cyanidation is developed alongside the quiet delving of his geological father-in-law, William Pengelly; the work of a consultant to so strenuous a man as Charles Butters compares with the participation with his wife in the British Association meeting in South Africa; these are among the contrasts in the life of a man of gentle manners, wide culture, and persistent energy.

As a memorial of his special work in the development of gold metallurgy, Julian left 'Cyaniding Gold and Silver Ores,' a book written jointly with Edgar Smart and published in 1904. It is still the best textbook on cyanidation. Besides real scientific insight, he took pains in his writing, so that he wrote clearly. To our issue of October 1911, he contributed a paper on 'Losses in Cyanidation,' of which we said then that it had "the double merit of being prepared by a specialist who also happens to be able to express himself clearly, in other words, he has subjected his writing to a process of filtration, in which, however, a vacuum is conspicuously lacking." Mrs. Julian quotes this in her book, and we are glad of it. No compliment was ever more sincere. The book also contains a friendly note of appreciation by H. L. Sulman, who knew Julian well in their early days on the Rand. To those who knew him the loss of the *Titanic* is for ever associated with the abrupt end to his useful career. He was one of the gallant men that stood-by while the women disembarked in the boats. We were acquainted with seven men on that ill-fated ship, and all seven, we feel confident, met their fate unflinchingly. Julian would not have been on board but for his keen sense of duty, requiring him to proceed to New York promptly in connection with the litigation over the Butters filter. And so the end. And his devoted wife, instead of throwing a wreath to the cruel Atlantic, writes this book and leaves a record that, mournful as it must be in its final phase, leaves a stimulus to the living, more particularly the members of a profession that is proud to claim Henry Forbes Julian. T.A.R.

Lindley on Mines. A Treatise on the American law relating to Mines and Mineral Lands. By Curtis H. Lindley. In three volumes; 2811 pages, illustrated. San Francisco: The Bancroft Whitney Company. Price five guineas net.

This is the third edition of a book of reference recognized in the United States as the most authoritative on mining law. While intended primarily for legal practitioners, it appeals to the mining engineer and geologist in that it deals with problems of immediate importance to those engaged in the operation of mines. The author is not only a leading member of the American bar, but one of the most influential citizens of San Francisco.

While these three volumes are devoted mainly to

the American phase of the subject, it is natural that the scholarly scope of the work should include adequate reference to the laws obtaining in other countries. This is done in the first chapter, of 37 pages. Among the ancient customs in England we may note that the extra-lateral feature or right to follow the vein indefinitely on its dip appears among the regulations in Derbyshire, as recorded by Thomas Houghton in 1681. The same idea is apparent in sundry Spanish and Mexican ordinances, modified however to the extent that the right of extra-lateral mining was limited to the line where the apex miner's workings broke into those of his deep-level neighbour. There he had to desist, being given the privilege of modified trespass across his own side-lines vertically extended, as "a reward for diligence." In other words: "first come, first served."

Next we have a historical review of the growth of mining law in America. The extraordinary diversity of legislation in the various States, and the diverse reasons for it, prepare the reader for some of the complications ensuing. The policy of the Federal government has varied with the development of the mining industry, and the incidence of that policy has changed as the various territories have been brought into the union of States. Indeed, the history of the mining law reflects the development of the mineral industry in America.

There follows a series of chapters on the acquirement of rights to mineral land, with fascinating definitions of the principal terms involved. The location of mining claims being limited to 'mineral,' as against 'agricultural,' land, it follows that the right to exploit has hinged often on the judicial interpretation of 'mineral' and 'mineral land.' Here we begin to see the beginnings of difficulty in harmonizing geological with judicial concepts. The removal of that difficulty is the principal function of 'Lindley on Mines.' We, as laymen, are taught that principles of law are usually more sound than theories of geology; we find also that the law is read in the light of history and the public interest. We become less impatient of judicial definitions of 'lode' or 'vein,' as we follow the development of jurisprudence and remember concurrently how much the scientific definition has divagated from its first effort to crystallize theory into a word. The mining acts, Judge Field said, "were not drawn by geologists, or for geologists." They were framed for the protection of those who owned mining claims and were prepared to work on them. Here we pass easily to the 'law of the apex,' that particular regulation to which the American mining law owes its notorious belligerency. This also happens to be the phase of litigation that involved the services of mining engineers and geologists, often to the obfuscation of law and the prostitution of geology. It has been said by a sardonic commentator that the mining expert in a law-suit is like necessity in being the mother of invention. A more kindly observer, Mr. George F. Becker, once remarked that "the difference between judicial and scientific geology has long since been recognized."

In the beginning the miners made their own local regulations; some of them were wise, others otherwise; they originated a system that was perpetuated when the frontier mining districts became parts of an organized state. The law of the apex and its corollary, the extra-lateral right, were born of the idea that a vein was a simple plane of fracture. The outcrop was the 'apex.' The right to follow it in depth within the limits of his end-lines seemed reasonable to the miner in Colorado and California sixty years ago. He was exploiting a relatively simple type of lode,

and had no premonition either of the complexities due to the crossing of simple types or of the wider range of complication to be found in deposits of a totally different type. The difficulties due to intersections in strike or dip, to conflict of boundaries, to broad outcrops, and to the thousand departures from a theoretical regularity, were not foreseen. By reason of them, and the financial issues at stake, the records of the mining law are enriched with a voluminous literature, some of which may not be edifying, but much of which is highly instructive. In Judge Lindley's volumes, particularly Volume II, we are furnished with a number of celebrated examples of the interplay of law and geology, in the effort to harmonize discords of fact and theory. To the mining engineer this part of the work makes particular appeal, teaching him not only law, but no small measure of applied geology. Excellent diagrams facilitate the reading of the text. All of the bigger cases involved a conflict of testimony between geologists and engineers of recognized eminence; indeed, some of them became famous for their ability to elucidate complicated rock-structures before judge and jury. Of these, Dr. R. W. Raymond is easily first, but litigation of this kind at one time was so prevalent as to engage the labours of a large body of alert minds, notably Clarence King, Ross E. Browne, Louis Janin, D. W. Brunton, and Walter H. Wiley. The participation of these mining geologists—as 'experts'—served inevitably to expose the weak spots in the mining code, and led geologists and lawyers to co-operate in proposals for betterment. Incidentally, we may remark that the interplay of the sciences—for law is more scientific than geology—is well typified in the person of Dr. Raymond, who is officially qualified as a practitioner of both. So also we can well imagine that Judge Lindley's wide experience in mining lawsuits, with the geological study incidental to them, has given him a knowledge of rock-structure and ore deposition more thorough than that of most of the men that go down the mine in skips. They, with us, will recognize that he has not only placed Bacon's aphorism on his title-page, but that he has lived up to it by paying the debt due to his own profession, and that he has proved "a help and an ornament thereto."

T.A.R.

The Metallurgy of the Non-ferrous Metals. By William Gowland. Cloth, octavo, 500 pages, with many illustrations. London: Charles Griffin & Co. Price 18s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

In spite of an otherwise ample supply of metallurgical literature, we have never yet had a concise book giving an outline of everyday practice in the extraction of metals from ores. The chief difficulty of the author of such a book is to know where to stop, and he also requires courage to discard the attempt at finality. Some of the German colleges have marvellous compendiums of metallurgical knowledge, but these lack point and the eclectic faculty. Schnabel's book is by far the best of these, and Louis' translation has popularized it in this country, but it is too voluminous to be used as a text-book. Percy started a book on general metallurgy, but its object and scope altered during its construction, and, from an outline, developed into a record of the author's knowledge and experience. Hofman's series now in course of publication partakes of the encyclopedic, and succeeds admirably in its object, though it is too full and learned to be suitable for the comparative beginner. Other general books are more in the nature of a study of the underlying principles of metallurgy, or of a preface that is best

read after mastering the facts. We welcome the volume presented to us now by Professor Gowland. It will not only be a help to the students at the Royal School of Mines, but to the new professor. Its publication removes the reproach that the School has never had a home-made text-book of this character. It is vastly clearer and fuller than the American compilation used a year or two ago. Moreover, the volume adds distinction and an element of completeness to the famous series of metallurgical works published by Charles Griffin & Company.

As we have said, the book consists of a record of practice rather than a disquisition of scientific principles. The metals discussed are copper, lead, gold, silver, platinum, mercury, zinc, cadmium, tin, nickel, cobalt, antimony, arsenic, bismuth, and aluminium, and there are chapters on refractory materials, roasting, and fluxes and slags. Under each metal are considered: (1) Its physical and chemical properties; (2) The alloy of which it is the chief constituent; (3) The composition and applications of commercial brands and the effect of substances that interfere with those applications; (4) The chief useful minerals and the processes by which the metal is extracted from them or other sources; (5) The principles and conditions on which the success of these processes depend; (6) The furnaces or appliances employed in the processes, and the chemical changes and reactions that occur in the operations; (7) Examples of actual practice followed at the present time in important extraction works.

We are pleased to see the account of the methods of sale of various qualities of copper and tin, and we find the chapter on roasting furnaces useful, as it collects much scattered information. It is probable that many readers will differ from the author in detail as to the advisability of including or omitting references to specific processes or methods. For instance we should have extended the very brief section on the hydro-metallurgy of copper, and have omitted much of the matter relating to unproved processes connected with zinc. But this is merely a matter of opinion.

The book is undoubtedly a valuable guide to the main facts of commercial metallurgy. We are grateful to the professor, who, like Aristides, was recalled from his exile, for providing his Alma Mater and all of us with so excellent a text-book. E.W.

A Text-Book of Geology. By James Park. Cloth, octavo, 554 pages, with many illustrations. London: Charles Griffin & Co. Price 15s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This work is described as a revision and expansion of a course of lectures "covering the requirements in geology as now defined for engineering, mining, and agricultural schools and colleges," and comprises 554 pages of text and a good index. It is obviously a book for students, written in a clear convincing style and from an unprejudiced standpoint. It should take a well deserved place among the many good text-books that threaten to form an *embarras de richesses* for the student. The aim of a new text-book can only be to bring up to date certain aspects of the subject, or to present facts in a novel and original manner. There is no attempt at originality in Professor Park's book, but a commendable effort has been made to incorporate some of the recent advances in the science. Old well-worn analogies, such as that between the crust of the earth and the wrinkled skin of a dried apple, find their usual place; and from a student's point of view many of them are too apt and excellent to be discarded. On the other hand many modern topics are introduced; cautious and impartial references are included to such

questions as the erosive *versus* protective action of glaciers, faunal differences in the same plane of deposition, the occurrence of deep-sea shells in shallow-water deposits and *vice versa*, the formation of avalanche slides, the importance of the distinction between contemporaneity and homotaxis, etc. The text is copiously illustrated; many of the figures and plates are new to ordinary text-books and only a few old friends are to be found. An excellent system of summaries to each chapter should prove of considerable value to the student.

The first ten chapters deal with the physical side of the subject, those on denudation, rock-building, and glaciation being especially comprehensive. The chapter on minerals fails in the way such brief sketches must fail. Such hazy impressions as are conveyed by the descriptions of serpentine, nepheline, fluorite, olivine, and others, seem hardly worth producing. The classification of igneous rocks is also a little short, while two pages scarcely seem necessary to describe how to convert a magnetic into a true bearing. In 184 pages the author has succeeded in giving an admirable sketch of the stratigraphical side of the subject. I should like to suggest that (1) the terms Pelecypoda and Bryozoa, if not actually adopted in place of the older terms Lamellibranchiata and Polyzoa, should not be entirely omitted; (2) the subgenera of Ammonites might be given in the text as well as in the diagrams; (3) a few geological sketch-maps would enhance the value of the many excellent sections; (4) the Laurentian, described as younger than the Keewatin, should be placed above the latter in the table on p. 307; (5) something more up-to-date should be substituted for Dana's ancient table illustrating the progress of animal and plant life, or at least the obsolete term 'acrogen' defined.

The only serious fault of this useful book is the absence of references. It is surely desirable that a student should be directed to the sources from which the new material has been derived, the incorporation of which appears to be the main reason for the production of a work like that under review. The addition of reference notes would greatly increase the value of the second edition which the book will probably merit.

E. H. PASCOE.

Roberts-Austen : A Record of his Work. Compiled and Edited by Sydney W. Smith. Cloth, octavo, 380 pages, illustrated. London: Charles Griffin & Co. Price 21s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

That Roberts-Austen was in many ways a distinguished man and that he won the objects of his ambition in the scientific world, there is no gainsaying, but from the point of view of the students of the Royal School of Mines his career and his methods were far from ideal. As a teacher of youth he was not a success, and lack of personal sympathy with the individuals constituting his classes was a never-ending discouragement to the beginner. Perhaps he was not interested in the art of extracting metals from their ores, and that he gave his whole soul to what is now called metallography. Perhaps the wretched emolument attaching to the professorships at the Royal School of Mines was an insufficient inducement to devote sufficient time to the duties, and that the assumption by him of the post was only prompted by such glamour as went with it.

Nevertheless, it would be churlish on our part not to receive this record of his life's work in the spirit in which it is written. The author was one of his helpers at the Royal Mint, and is now assistant-assayer there.

He can speak truly of Roberts-Austen as an enthusiastic investigator on alloys, pyrometry, and the physical chemistry of metals. He can say without fear of contradiction that Roberts-Austen won fame in many branches of metallography, that he notably advanced the art of measuring temperatures and the application of the results obtained as an arm of investigation, and that he was the first to define the vast effects of minute quantities of impurities on the physical characteristics of metals. If Roberts-Austen did not give of his best at the School courses, he certainly shone brilliantly as a lecturer before the learned societies. His Friday evening discourses at the Royal Institution were intellectual treats, and he was highly successful when impressing on an audience of engineers the necessity for closer attention to the thermal and molecular changes in masses of metal in preparation for structural purposes. Mr. Sydney Smith's book consists largely of reprints or extracts of addresses and lectures of this character, and in this way gives a clear record of the subjects in which Roberts-Austen was interested, his method of expounding them, and his own contributions to the advance in knowledge. In closing this review we desire to voice our appreciation of the services rendered by Roberts-Austen to the publishing house of Charles Griffin & Co., in connection with their unrivalled series of metallurgical text-books. E. W.

Dictionary of Spanish Mining Terms. Second Edition. By Edward Halse. Cloth, octavo, 440 pages, illustrated. London: Charles Griffin & Co. Price 10s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

It is six years ago since Mr. Halse presented his dictionary of Spanish and Spanish-American mining terms to his grateful and appreciative fellow-engineers. He combines the many qualifications requisite for the production of a work of this character. He is a learned geologist, an experienced mine manager, an enthusiast for research, and has an intimate knowledge of the Spanish, Spanish-American, and Portuguese-American languages acquired by long residence in countries where they are used. The second edition of the book, now published, contains a large number of additional words, and a new supplement to serve as an indicator in translating English terms into the Latin-American languages.

Compressed Air. By Theodore Simons. Cloth, octavo, 180 pages, illustrated. New York: McGraw-Hill Book Co. Price 6s. 3d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is written by the professor of mining engineering in the Montana School of Mines, and is intended to give the student an insight into the natural laws and physical principles underlying the production, transmission, and use of compressed air.

A Primer on the Storage of Petroleum Spirit and Carbide of Calcium. By Major A. Cooper-Key. Cloth, octavo, 135 pages. London: Charles Griffin & Co. Price 2s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Mining engineers are universally interested in the winning of oil, and some of them own motor-cars. This book will be of interest to the latter class. The author is the Chief Inspector of Explosives for Great Britain. He discusses the nature of petroleum, petrol, benzol, and allied fuels, the government regulations relating to their storage and use, and the management of stores and garages. A chapter is devoted to the applications of calcium carbide and acetylene.

COMPANY REPORTS

Pretea Block A.—This company was formed by Edmund Davis in 1903 to acquire a property in West Africa from the Pretea and Appantoo companies. Milling commenced in 1906, but was suspended from 1909 to May 1911, pending additional development. In 1909, Wernher, Beit & Co. subscribed for 200,000 new £1 shares at 24s., and later took 50,000 at 27s. 6d. Subsequently 70,000 shares were taken by shareholders at 27s. 6d. each and 30,000 shares at 32s. 6d. each. Part of these funds was devoted to the building of a new mill. In January 1911, the property of the Pretea company was absorbed in exchange for 199,876 shares. As still further capital was required, £150,000 was advanced on loan by the Central Mining & Investment Corporation and the Fanti Consolidated. Hugh F. Marriott is consulting engineer, and William Crosley is manager. The report for the year 1913, now issued, shows that 229,990 tons of ore was raised and treated, an increase of 57,000 tons as compared with 1912. An average of 80 out of 110 stamps were at work. The yield by amalgamation was 64,593 oz., 4408 tons of concentrate was roasted and cyanided for a yield of 19,324 oz., and 171,461 tons of sand was cyanided for a yield of 7122 oz., making a total yield of 91,039 oz., worth £386,918, or 33s. 7d. per ton. The average assay of the ore treated was 41s. 6d., so that the recovery was 81%. The gold left in the sand was 6s. 9d., and in the concentrate residue 23s. 1d. The slime amounting to 54,121 tons averaging 10s. 7d. per ton was not treated, but is being accumulated for future consideration. The metallurgical difficulty at this mine is the presence of graphitic shale in the country rock. Experiments are being continued with a view to improving the extraction, and the advice of W. R. Feldmann, who has had a similar problem at the Ashanti Goldfields, has been sought. During the year, the Main shaft has been sunk to 938 ft., and the North shaft to 1024 ft. The development totalled 5660 ft., and 81,623 tons of ore averaging 30s. 6d. was disclosed. The ore reserve on December 31 was estimated at 691,670 tons averaging 41s. 4d. The cost during the year, including interest on loan and depreciation of plant, was £348,593, or 30s. 4d. per ton. The balance of profit was £38,340, which was carried to the balance sheet. During the year, the loan was reduced by £25,000, and now stands at £125,000, which is to be liquidated as to £50,000 on or before December 31, 1915, and, afterwards, as to the remainder, in monthly instalments of £2500. The issued share capital is £1,049,876. The lending companies have options on an additional 100,000 shares at par.

Tanganyika Concessions.—This company was formed by Robert Williams in 1899 to acquire a concession in Northern Rhodesia from the British South Africa Company. On this concession, the Kansanshi copper mine was developed, and it is now worked by the Rhodesia-Katanga Junction Railway company, of the issued capital of which the Tanganyika company owns 70%. Subsequently the Katanga district, over the border in the Congo state, became the scene of the company's operations. Concessions were acquired by the Union Minière du Haut Katanga, a Belgian company, in which the Tanganyika company now owns a 39% interest. The history of the Tanganyika enterprise has been given many times in our pages. In our last issue an elaborate article on the subject appeared, by S. H. Ball and M. K. Shaler. The report of the company for 15 months ended December 31 shows that at the three copper mines, Star of the Congo, Kambove, and Luushia, 81,000 tons of ore was smelted,

for a production of 7245 tons of bars averaging 95 to 96% copper. The profits accruing to the Belgian company are being devoted to an extension of operations. Three furnaces have so far been erected, and four more are on order. Coke-ovens were started in March, and the output of coke is about 3000 tons per month. The coal used comes from the Wankie mines. The Benguela Railway company, of which the Tanganyika holds 90% of the share capital, reports that the line is open to Chinguar, a distance of about 350 miles from Lobito Bay. A further 1000 miles is to be constructed before the line reaches Kambove. The Rhodesia-Katanga Railway is earning profits from freight, but the Kansanshi mine is practically idle owing to lack of labour. The company is also exploiting diamond pipes at Kundelungu. During 1913, 4390 loads of ground was washed yielding 218 small diamonds. The accounts show that £139,864 was paid as debenture interest, there being a total issue of £2,221,283, and £38,300 was spent on administration. These funds were provided out of share-premium reserve. The share capital issued stands nominally at £966,098.

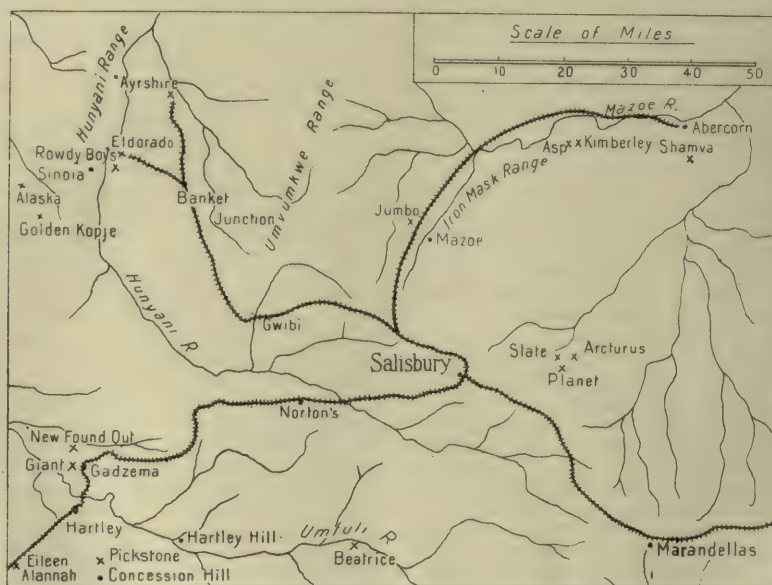
Ropp Tin.—This company was formed by Edmund Davis in 1911 to acquire prospecting licences over areas to the southeast of Bukuru, Northern Nigeria. Five 21-year leases have been obtained, and application for others has been made. So far, mining has been confined to calabashing. The report for the year 1913 shows that 321 tons of tin concentrate was recovered in this way, and that 350 tons was shipped. The income from the sale of the concentrate was £43,445, and the cost of mining and transport was £12,703. After the payment of London expenses and making allowance for depreciation, the net profit was £24,028, out of which £15,000 has been distributed as dividend, being at the rate of 50%. In order to provide further funds for development, a scheme has been put forward whereby the capital of £30,000 in £1 shares is to be split into 150,000 shares of 4s. each, and an additional 75,000 shares of 4s. created, to be offered to shareholders at £1 each. In this way £75,000 will be provided. The report of the superintending engineer, J. F. Balfour, gives details of recent developments; and the report is also published of W. E. Thorne, who was engaged to report on the best methods of working the properties. Mr. Thorne recommends that a 2½-ft. bucket-dredge should be used on Dome River Section 1, where the company's engineers estimate over a million cubic yards to contain an average of 4½ lb. cassiterite per yard, and that a similar dredge should be erected on South River Section 1, where 1,174,000 cu. yd. is estimated to average 6½ lb. per yard. Sections 2 and 3 on South River also contain smaller tracts suitable for dredging. At other places hydraulicking is recommended. The dredging cost, including redemption, is estimated by Mr. Thorne at 11½d. per yard, and the cost of hydraulicking at 16½d. As regards transport facilities, the directors state that the railway is completed to Bukuru, which is 2 hours by motor from the Ropp properties.

Wanderer (Selukwe) Gold Mines.—This company was formed in 1899 to acquire the Wanderer, Ashton, and other gold mines in the banded ironstones of the Selukwe district of Rhodesia. Edmund Davis is chairman, Noel Griffin is consulting engineer, and Stanley Fletcher is manager. No dividend has ever been paid. The grade of ore is low and the working cost is in proportion, but the company has not done more than pay its way. The report for the year ended April 30 shows that the ore treated was 150,062 tons, as compared

with 222,445 tons the year before, the cause of the fall being the exhaustion of the Camperdown property. The yield of gold was worth £74,135, or 9s. 10d. per ton, and the working cost was £46,996 or 6s. 3d. per ton. The cost, however, did not include depreciation, for which £26,515 had to be allowed, and London expenses £1408. The net profit for the year was only £1789. During the year, 188,489 tons of ore was developed in the Wanderer, Kemerton, and Ashton sections, and on April 30 the reserve was estimated at 102,300 tons, of which 86,800 tons was in the Wanderer, 8500 tons in the Kemerton, and 7200 tons in the Ashton. The Kemerton and Ashton are now practically exhausted, but work is still to be done in the Wanderer, though in ore that is harder than formerly. The directors have decided, owing to the contraction of operations, to reduce the capital from £150,000 to £90,000, by returning 2s. in cash per share to the shareholders, and altering the denomination of the

capital of the company is £410,000 in shares of £1 each, of which 160,000 were subscribed at 22s. 6d. each.

Golden Kopje Proprietary.—This company was formed in 1912 by the Gold Fields Rhodesian Development Co. to acquire the Golden Kopje and Union Jack mines situated in the Lomagundi district of Rhodesia. The report for the year ended March 31 shows that the shaft at the Golden Kopje has been sunk to a depth of 286 ft. and lined with steel sets. The head-gear has been erected and the winding engine is in course of construction. At the Union Jack the head-gear is completed. No development work has been done, and the reserve stands as it was a year ago: at the Golden Kopje 210,204 tons averaging 6 dwt.; and at the Union Jack 45,034 tons averaging 13 dwt., together with 41,508 tons of probable ore averaging 13·6 dwt. The metallurgical plant consisting of 50 stamps has been transferred from the Ayrshire mine, and in addition 3 tube-mills, Burt filters, and other cyanide plant



THE COUNTRY ROUND SALISBURY, RHODESIA.

shares from 5s. to 3s. The company has sufficient cash reserve wherewith to make this distribution.

Eileen Alannah.—This company was formed in 1911 as a subsidiary of Willoughby's Consolidated to acquire a mine in the Gatoma district of Rhodesia, near the Cam & Motor and Eiffel Blue mines, that had been previously developed and let on tribute. The company took-over the 10-stamp mill from the tributer. The treatment of the ore, which contains arsenic and antimony, was studied with a view to erecting a plant with a capacity of 5000 tons per month. As we have already recorded, F. A. Marriott has had the matter in hand and has prepared plans for an improved process. The report for the year 1913, issued last month, shows that the old tributers' mill was re-started at the beginning of December 1913, and that during the six months to the end of May, 11,174 tons was treated yielding gold worth £26,271, and providing a working profit of £18,150. The funds thus obtained are allocated to the payment for the new plant. It is expected that the first section of this plant will be erected by October and the remainder by March 1915. The

have been purchased. It is hoped that the plant will be at work this month. The issued capital of the company is £448,568, of which £224,868 represents vendors' shares credited as paid, and £223,700 subscribed in cash. The company requires further capital to the extent of £24,000 pending the commencement of production, and this sum has been raised by loan. H. A. Piper and W. F. H. Dudgeon are the consulting engineers.

Eldorado Banket.—This company was formed in 1906 by the Rhodesian Exploration & Development Co., to acquire the Eldorado gold mine in the Lomagundi district of Rhodesia. Two years ago the control passed to the Gold Fields Rhodesian Development Co. H. A. Piper is consulting engineer. Dividends averaging 30% have been paid since 1908. Eighteen months ago serious caving took place in the ground between the 2nd and 7th levels, with the consequence that the ore has been mixed with worthless rock and the average grade of the material extractable lowered. The report for the year ended March 31 shows that the Parallel lode has been proved unprofit-

able below the 8th level, so that operations are now confined to the Main lode. The main vertical shaft was sunk 587 ft. during the year, down to 1567 ft. The orebody has been developed on the 11th, 12th, and 13th levels at 1255 ft., 1373 ft., and 1490 ft. respectively, and the lengths of the orebody on these levels are 120 ft., 130 ft., and 65 ft. respectively, the assays averaging 13·4 dwt. over 8½ ft., 12·9 dwt. over 11 ft., and 20·4 dwt. over 10 ft. Pending the results of developments on these levels, the grade of ore sent to the mill was decreased from 12 to 8 dwt. in July of last year, and at the beginning of January of this year the tonnage was decreased from 7500 to 4500 per month, the grade being at the same time increased so as to maintain the working profit at over £4000 per month. The total ore milled during the year under review was 82,471 tons, for a yield of 37,489 oz. worth £159,504. The net profit was £66,087, which,

additional information up to June 8 of this year is included. The engineers, H. A. Piper and W. F. H. Dudgeon, state that development was stopped in October last owing to lack of compressed air. At that time the developed ore totalled 2,405,796 tons averaging 5·01 dwt. gold per ton. The lengths, widths, and assay-values of the orebody on each level are given as follows: Prospect level, 740 ft. long, 88 ft. wide, assaying 3·8 dwt.; first level, 920 ft. long, 110 ft. wide, assaying 4·14 dwt.; second level, 820 ft. long, 97 ft. wide, assaying 6·77 dwt.; third level, 510 ft. long, 29 ft. wide, assaying 5·55 dwt. The fourth level has not been completely developed, but for 150 ft. the orebody is 62 ft. wide and assays 5·36 dwt. A winze is to be sunk from the 3rd level in order to prove the mine on a fifth level. The mill contains 56 Nissens and 10 tubes. The first section was started at the end of January last, and the full plant was at work at the



THE SHAMVA MINE AND MILL.

added to £54,766 brought forward from the previous year, made an available balance of £120,853. Out of this, £90,000 has been distributed as dividend, being at the rate of 30%, and £3000 has been paid to the directors as percentage of profit. The ore reserve on March 31 was estimated at 47,950 tons averaging 13·7 dwt., as against 74,826 tons averaging 16·4 dwt. the year before. Of the present reserve, the ore ready for stopping was 22,396 tons averaging 11·3 dwt. in the Main lode and 565 tons averaging 8·4 dwt. in the Parallel lode, while 9000 tons is broken ore averaging only 6 dwt. The remainder is left behind in pillars, 13,451 tons averaging 23·7 dwt. being in the Main lode and 2538 tons averaging 10·7 dwt. in the Parallel lode.

Shamva Mines.—This company was formed in 1910 by the Consolidated Gold Fields of South Africa to acquire a large low-grade gold deposit in Rhodesia, 60 miles northeast of Salisbury. The orebody is wide and outcrops on the hill, so that it can be cheaply worked by adit. The ore has been called banket officially, but is really an agglomerate or a breccia. The report now issued covers the year 1913, and

beginning of May, during which month 46,730 tons averaging 3·41 dwt. yielded 5338 oz. of gold worth £22,487. The tailing assayed 0·25 dwt. leaving a discrepancy of 0·95 dwt. between the feed and tailing. This represents the gold absorbed in the plant, being 28% of the gold content of the ore. This absorption has been conspicuous from the start, having been 58% in February, 40% in March, and 7% in April, and many inquiries have been made relative to it. The working cost in May was 7s. 6d. per ton. In May, the experiment was made of removing the amalgamating plates, and it was found that the cyanide plant, working alone, gave as good an extraction. The nominal capital is £600,000 in £1 shares, of which 250,000 were allotted to the vendors, 150,000 were subscribed at par, 100,000 at £2 each, and 100,000 at 35s. each. The money thus raised did not prove sufficient, and there is an overdraft at the bank of £54,000, to be repaid out of revenue. The extension of the Blinkwater railway to the mine was opened on April 1913. The company guarantees a yearly income of £7500 for 10 years to the owners of the railway.

Willoughby's Consolidated.—This company was formed in 1894 to consolidate various land and mining interests in Southern Rhodesia, owned by Sir John Willoughby and others. The control is now with the British South Africa Company. The only dividend ever paid was one of 5% for the year 1910. The capital is £700,314, and there are £194,800 debentures. The report for the year 1913 shows that the company continues to work the Eiffel Blue mine, lets on tribute the Alice-Atlas, Broad Arrow, Blanket, Camelia, Bonsor, and North Bonsor, and continues to hold an interest in Matabele Queen's, Eileen Alannah, and Connemara. The interests include many other mines of no present importance, and the company holds extensive tracts of land that may be eventually profitable to agriculturists. At the Eiffel Blue, 17,918 tons of ore was milled yielding 7744 oz. gold worth £32,603, the net profit being £7140. The royalty accruing to the company from the tributers totalled £3475. Of the leased properties the North Bonsor gave the only notable output, the ore treated being 24,125 tons and the yield £25,317. Particulars of the subsidiary Matabele Queen's were given in our issue of July, and the Eileen Alannah forms the subject of a paragraph in this issue. As regards the Connemara, a plant to treat 6000 tons per month is to be erected whenever the necessary funds can be raised. The accounts for the year show that after £10,190 was paid as debenture interest, a net profit remained of £15,725, which was carried forward.

Transvaal Gold Mining Estates.—This company, belonging to the Central Mining group, is by far the largest gold producer in the Transvaal outside the Witwatersrand. The properties are at or near Pilgrim's Rest, and have been worked since 1895. There are three separate groups; the largest, called the Central Mines, is at Pilgrim's Rest, and consists of seven different workings, of which Duke's Hill, Peach Tree, Theta, and Graskop are the most important; the Elandsdrift mine is 20 miles south of Pilgrim's Rest, and the Vaalhoek 12 miles north. S. Aimetti is general manager for the company, George Carter is manager of the Central Mines, W. Patrick of the Elandsdrift, and H. A. Tute of the Vaalhoek. Electric power is obtained from a waterfall on the Blyde river 20 miles north of Pilgrim's Rest. The report for the year ended March 31 shows that at the Central Mines 139,976 tons was raised and sent to the mill, which contains 60 stamps and 3 tubes. Of the ore, 55,303 tons came from the Peach Tree, 43,678 tons from the Duke's Hill, 23,893 tons from the Graskop, and 17,102 tons from the Theta. The yield of gold was 53,070 oz. by amalgamation and 44,134 oz. by cyanide, the total value being £408,407 or 58s. 1d. per ton. The working cost was £154,662 or 22s. per ton. The developments at most of the workings have been highly satisfactory, and the reserve on March 31 showed a slight increase in tonnage and content as compared with the year before, the total figures being 389,233 tons averaging 14.4 dwt. At the Elandsdrift mine, 8053 tons of ore was mined, principally from the open-cut; 7797 oz. gold was extracted by amalgamation and 1121 oz. by cyanide, the total being worth £37,442, being 93s. per ton. The working cost was 28s. 7d. per ton. The reserve is estimated at 38,270 tons averaging 16 dwt. At the Vaalhoek, 17,860 tons was raised and treated for a yield of 2442 oz. by amalgamation and 4367 oz. by cyanide, the total being worth £28,574 or 32s. per ton. The working cost was £17,481 or 19s. 7d. per ton. The ore reserve has been substantially increased during the year, the figures on March 31 being 54,651 tons averaging 11.4 dwt. The total working profit ob-

tained from the three groups of mines was £291,235, and £226,584 was distributed as dividend, being at the rate of 37½%. When the hydro-electric station was built in 1910, the money required was raised by the issue of £124,000 debentures; of these, £32,580 have been redeemed. For many years Pilgrim's Rest has been handicapped by absence of railway communication. This disability has now been partly removed by the completion of the branch line from Nelspruit, on the main line of railway between Pretoria to Komati Poort. This branch has been built as far as Graskop, 9 miles from Pilgrim's Rest.

New Rietfontein Estate.—This company was formed in 1892 to acquire the Du Preez mine, on an isolated lode 8 miles north of Johannesburg. Other properties were subsequently purchased, and there have been several rearrangements and reconstructions. Milling commenced in 1892 with 20 stamps, and the equipment now consists of 120 stamps and 3 tube-mills. Shares were at various times subscribed by the Consolidated Gold Fields, A. Goerz & Co., and the Johannesburg Consolidated or Barnato group, and the control is with the last-named. Some satisfactory dividends were paid until 1909, but since then the distribution has been small, and the mine is now in a doubtful position. The report for 1913 shows that 216,039 tons of ore was raised, and after the rejection of 14% waste, 185,830 tons averaging 5.45 dwt. per ton was sent to the mill. The yield by amalgamation and cyanide was 46,908 oz., worth £199,415, being 5.05 dwt. or 21s. 5d. per ton milled. The working cost was £185,189, or 19s. 11d. per ton, leaving a profit of £14,225 or 1s. 6d. per ton. The dividend absorbed £15,252, being at the rate of 2½%. The reports by J. G. Lawn, the consulting engineer, and C. Marx, the manager, state that the grade of ore has gradually fallen, until in December the operations were conducted at a loss. The yield throughout the year was 4s. per ton lower than in 1912. The developments at the bottom of No. 1 shaft, which was sunk 215 ft. to a depth of 1814 ft. during the year, have been disappointing. The lode is much faulted and little ore was disclosed. The reserve in the mine on December 31 was only 51,737 tons, averaging 7.55 dwt. per ton. It is impossible to continue working the mine on the former scale, and a modified scheme is being considered.

Princess Estate & Gold.—This company was formed in 1888 to acquire property in the west Rand, in the Roodepoort district. In 1911 deep-level mines were purchased from the Roodepoort Central Deep and West Roodepoort Deep companies. The control is with the Goerz group. Milling commenced in 1892. A new mill of 30 stamps was erected in 1895 and a further 30 stamps were afterwards added. On the purchase of the Roodepoort Central Deep, 50 stamps were included in the transfer. Dividends were paid in 1897 and 1899, and from 1908 to 1911. The issued capital is £575,033, and £26,386 has been advanced by A. Goerz & Co. The report for the year 1913 shows that 360,029 tons of ore was mined, and after the elimination of 28% waste above and below ground, 257,478 tons, averaging 6.2 dwt. per ton, was sent to the mill. The number of stamps at work was 60, and tube-mills 5. The yield of gold was 78,798 oz., worth £333,759, being 6 dwt. or 25s. 5d. per ton milled. The working cost was £315,865, or 24s. 1d. per ton, leaving a profit of £17,894, or 1s. 4d. per ton. The yield per ton was 6d. less than in 1912, and the working cost 1s. 8d. lower. Out of the profit, £3052 was paid as interest on advances, and £10,337 was written off for depreciation of plant. Owing to scarcity of

native labour following the strike of July last, the amount of development was restricted and the reserve was not maintained; the figures on December 31 were 482,000 milling tons in the South Reef, averaging 7.5 dwt. per ton, and 132,000 milling tons in the Main Reef, averaging 5.9 dwt. It will be necessary to push development if the present rate of output is to be maintained, but the company's finances are in so uncertain a condition that the future prospects of the property give cause for anxiety. W. M. Cameron is consulting engineer, and P. von M. Anderson is manager.

Burma Ruby Mines.—This company was floated 25 years ago by the Rothschilds, for the purpose of acquiring the ruby and sapphire gravel-mines at Mogok, Burma. At the time, the shares were supposed to be of enormous potential value, and the subscription was unprecedentedly great. The expectations have not been verified, for the profits have been small, the sale of the products restricted, and the extent and content of the ground less than supposed. The rent and royalty demanded by the government, though insignificant when the original estimates of output and profit were made, have proved oppressive. Not only has the capital of the company been written down, but dividends were absent for some years. A year ago we recorded the resumption of dividends, 2½% being paid on the reduced capital of £180,000. The report for the year ended February 28 last, however, shows that another set-back has occurred, for the result of the year's work has been a deficit of £9065. The number of loads washed was 1,148,155, as compared with 1,383,146 the year before, and the cost per load was 9.09d., as compared with 7.77d. The low returns from the Mogok mines are causing anxiety. The Kathé property, 8 miles away, that was recently acquired, is giving better results, and it is hoped that it will restore the fortunes of the company. The sales of stones continue to decrease, the income being £46,566 as compared with £65,647.

Orsk Goldfields.—This company was formed in 1906 by the Siberian Proprietary to acquire gold mines in the province of Orenburg, South Russia. Hooper, Speak & Co. are the consulting engineers. These mines proved valueless, and subsequently in 1909 a gold-gravel property was acquired near Nicolaievsk on the Okotsk sea, in Eastern Siberia. Several eminent engineers have superintended operations, or have advised on the placer property, namely, C. W. Purington, D'Arcy Weatherbe, and C. H. Munro. W. H. Lanagan was appointed manager two years ago. A dredge was ordered from New York, but owing to an accident during transport, its arrival on the ground in the Kolchan valley was delayed a year, and it did not start work until 1911. In the meantime a stacker-scow was erected on the Pokrovsky property. During the winter of 1912-13, the stacker-scow was rebuilt as a dredge, at a cost of £13,000, very nearly as much money as would have bought a new dredge. But the advantage accruing has been proved to be great, as the total operating cost as a dredge is slightly less, the capacity increased by 70%, and the cost per yard reduced by one-half. The report for the year 1913 shows that the Kolchan dredge was in commission from May 8 to November 13, during which time 382,800 cubic yards of gravel was treated, for a yield of gold worth £29,727, or an extraction of 18½d. per yard. The Pokrovsky dredge, during the period from June 28 to November 13, treated 117,500 yards for a yield of £15,465, being an extraction of 2s 7½d. per yard. The so-called operating cost at the Kolchan was £6070 and at the Pokrovsky £4243. Tributaries extracted gold worth £3740, of which £1685 was paid to the

company. The gross working profit was £36,563, but out of this had to be deducted £2739 as winter upkeep of the two dredges, £5929 as administration expenses in Russia, £5921 as royalty, £14,948 as depreciation, and £2237 as London expenses. The gross profit was thereby whittled down to a net profit of £679. The capital consists of £530,007 in ordinary shares, £79,500 in preference shares, and £80,000 in priority shares. The preference shares were issued when the placer property was acquired, and the priority shares when the finances were upset by the year's delay in the delivery of the Kolchan dredge. The accounts show sundry creditors £11,868 and a loan of £5000. Mr. Lanagan states that at Kolchan the yield per yard and the total yield will be lower during 1914. The yield at Pokrovsky will be maintained, as there are still stretches of gravel in the upper reaches of the creek to be worked before the exploitation of the lower-grade gravel below need be commenced.

Troitzk Goldfields.—This company was formed in 1906 to acquire from the Siberian Proprietary, of which Heyman Orkin was promoter, the Troitzk gold mine in the Kotchkar district of Orenburg, South Russia. Hooper, Speak & Co. are the consulting engineers, and J. R. Horsley is manager. A new plant consisting of Chilean mills and cyanide plant was built in 1909, and a slime plant was added in 1912. A fire destroyed the upper part of the main shaft in 1911, together with the greater part of the hoisting and pumping plant. Operations were in consequence at a standstill for 14 months. The report for the year 1913 shows that 39,500 tons of ore was raised and treated, yielding 8531 oz. by amalgamation, 2745 oz. by cyaniding sand and slime, and 379 oz. obtained from concentrate, being a total of 11,655 oz. worth £49,196. In addition gold worth £5103 was obtained from 16,653 tons of accumulated slime, making a total revenue of £54,299. The working cost in Russia was £42,672, allowance for development redemption £8315, depreciation £7016, and London expenses £1818. The loss for the year was £5523, as compared with a loss for 1912 of £14,028. The Main shaft has been sunk to 892 ft. and No. 2 shaft to 725 ft. The development done amounted to 2799 ft. The ore reserve on December 31 was 22,430 tons averaging 6.65 dwt., as compared with 26,270 tons averaging 7 dwt. the year before. The issued capital of the company is £500,007 in ordinary shares and £105,488 in priority shares. No dividend has ever been paid. The item of 'sundry creditors' stands at £10,793.

Spassky Copper Mine.—This company was formed in 1904 to acquire from local owners the Yuspensky copper mine, the Spassky mine and smelting works, and the Karagandy coal mine, in the Akmolinsk district of southwest Siberia. In 1911 a controlling interest in the Atbasar Copper Fields company was purchased, and in May 1913 the remainder of the share capital of that company was absorbed in exchange for Spassky shares, so that now the Spassky company owns the entire Atbasar enterprise. The report now issued covers the 15 months ended December 31 last, and shows that 43,591 tons of ore, averaging 22% copper, was raised from the Yuspensky mine, and that the smelter treated 33,665 tons for a yield of 6251 tons of copper. The copper sold brought an income of £481,241, and the net profit was £226,318. Out of this, £15,615 was paid as directors' percentage of profits, manager's commission, and bonus to the staff. The shareholders received £152,800, being at the rate of 5s. 1d. per £1 share. The reserve of first-class ore, as at present mined, at the Yuspensky was estimated on December 31 at 12,643 tons averaging 20% or over.

In addition, 30,257 tons of similar grade is on surface waiting treatment. Since the end of the year, 7100 tons has been developed between the 560-ft. and 630-ft. levels. The shaft is being sunk to 700 ft., where another level will be opened. Owing to the limited and precarious supply of this high-grade ore, attention has been turned to the ore of lower grade. It is difficult to give an estimate of the lower-grade ore, owing to the irregular distribution of the bornite and chalcopyrite, but the manager, H. C. Woolmer, considers that 342,882 tons averaging 7.1% copper may be assumed. In addition, 15,323 tons averaging 9% copper is on the dump. A plant is in course of erection for the concentration of this ore. As regards the Atbasar mine, the ore developed is estimated at 543,900 tons averaging 10.7% copper. A smelter is being built, on the design of W. G. Perkins, and should be ready by the end of 1915. Its capacity will be 5000 tons of copper per year.

£83,046 was allowed for depreciation, £23,843 was placed to reserve, and £58,408 to reserve for taxes, leaving a profit of £311,578. The English company distributed £314,058 as dividend, being at the rate of 25%, as compared with 22½% for 1912. The directors have issued the report of R. Gilman Brown, the consulting engineer. The amount of ore mined was 351,043 long tons, of which 135,249 tons came from the Koniukhoff, 165,389 tons from the Smirnof, and 47,371 tons from the Tissoff. The average content was 3% copper, 1.86 dwt. gold, and 1 oz. silver per ton. The total ore treated at the smelter at Karabash was 322,700 tons, together with 20,867 tons of low-grade matte, produced by the reverberatory at the old smelter from 17,153 tons of roasted ore, 14,530 tons of fine raw ore, and 26,542 tons of flue-dust. The blister copper, produced at Karabash, was 8413 tons, averaging 98.85% copper, 3.56 oz. gold, and 33.6 oz. silver per ton. At the refinery, 7971 tons of copper



VIEW OF THE SOYMONOVSK VALLEY FROM THE SMIRNOFF MINE, KYSHTIM ESTATES.

Kyshtim Corporation.—This company was formed in 1908 to purchase the entire share capital of the Kyshtim Mining Works, a Russian organization owning estates in the Ural mountains, containing copper and iron mines and smelters. The capital was £1,000,000, of which £250,000 was subscribed in cash, and £650,000 debentures have been issued. Of these debentures, £634,500 have been converted into 253,800 shares, bringing the share capital to £1,253,800, and leaving £15,500 debentures outstanding. Dividends were first paid in 1913, for the year 1912. We have on several occasions given details of the copper mines and works of this company, notably in our issue of April 1913. The report for the year 1913 shows that 7971 tons of copper was produced, and 7832 tons sold at an average price of £94, yielding a profit of £525,986. The ironworks brought a profit of £42,449, the forest department £27,013, and the sale of pyrite on sulphur content £2663. The administration expenses in Russia, interest, and taxes absorbed £129,432;

was produced, and precious metals worth £19 per ton of copper. The ore blocked-out on December 31 totalled 356,000 tons averaging just under 3% copper; of this, 51,600 tons averaging 2.85% was in the Koniukhoff, 232,300 tons averaging 2.8% in the Smirnof, and 72,400 tons averaging 3.59% in the Tissoff. The assured reserves as indicated by bore-holes and development are as follows: Koniukhoff, 505,000 tons; Smirnof, 384,000 tons; Tissoff, 415,000 tons; Amerikansky, 611,000 tons. In addition the ore assumed to exist within an average of 50 ft. below bore-holes is: Koniukhoff, 198,000 tons; Smirnof, 133,000 tons; Tissoff, 141,000 tons; Amerikan-sky, 74,000 tons. The total of assured and assumed ore is 2,461,000 tons, estimated to average 2.7 to 3% copper. The average metal content of the ore blocked-out appears to be lower than that of the ore hitherto mined. The explanation is that large amounts of lower-grade ore can be extracted profitably during current mining operations that would be otherwise

lost. A new orebody has been disclosed 2 miles south of Tissoff. This has been called the Ivanoff. The oxidized portion, on which development has been done, is high in gold and silver. The diamond-drill has intersected the lode at depth, where it is 9 ft. wide, and averages 2% copper. Since Mr. Gilman Brown's report was received, a bore-hole at Koniukhoff has cut the lode at a vertical depth of 1400 ft., where it is 6'3 ft. wide and averages 4'3% copper, 12'4 dwt. gold, and 8'3 oz. silver per ton. The capacity of the electrolytic refinery has been increased to 10,000 tons per year. A reverberatory furnace is being built at Karabash, to supersede the plant at the old works.

Sissert.—This company was formed in June 1912 to acquire the share capital of a Russian company owning an estate in the Ural mountains, containing copper, iron, gold, and platinum mines, and copper and iron

platinum. The accounts of the Russian company are not published, but the net profit is returned at £43,885. The English company has paid a dividend of £37,750, being 5% on the issued capital of £755,000. Since the close of the year under review, an option on 173,000 £1 shares at 35s. has been exercised by the promoters, the Russian Trust & Finance Co., and a further option on 166,500 shares at 30s. has been granted. Extensive drilling operations are now in hand. At the Gumeshevsky, drilling is being done to prove the orebody below the open-cut; as the results were successful, a shaft has been sunk, and an oxidized orebody is being developed. Additional ore has been proved in the Sysselsky. At the Krilatofsky gold mine, 158,000 tons of gold-bearing quartz has been blocked-out averaging 14s. 4d. per ton; this is to be used as flux in copper-smelting operations. The most interesting development, however, is at the Degtiarsky, where gossan outcrops are being tested by trenching and drilling. One orebody as far as proved is estimated to contain 250,000 tons of ore averaging 3'2% copper, 1 dwt. gold, and 0'53 oz. silver per ton. Other orebodies give promise of excellent development. The smelting plant is being extended and rebuilt on modern lines.

Broken Hill Block 10.—This company was formed in 1888 to acquire part of the Proprietary company's property at Broken Hill, New South Wales. The purchase price was £912,000, in 96,000 shares of £10 each credited with £9. 10s. paid, an additional 3s. per share being subscribed by the company. A further 4000 shares have been issued ranking with the others. The total issue of capital is £1,000,000 in shares of £10, on which £9. 13s. has been paid or credited as paid. Satisfactory dividends were paid from oxidized ore until 1900; then followed a period of depression, and from 1904 onward dividends on a greatly reduced scale have been the rule. The company three years ago built an Elmore plant for the treatment of the zinc tailing, but subsequently dismantled it and now sends the tailing to be treated by the Amalgamated Zinc (De Bavay's) company. A year ago the lead mill was extended and improved. O. B. Ward is manager. The report for the half-year ended March 31 shows that 48,739 tons of ore was raised and sent to the mill, averaging 12'1% lead, 12'9% zinc, and 8'9 oz. silver per ton. These assays show a gradual diminution during the last four half-years in zinc and silver, while the lead has been fairly well maintained. The yield of lead concentrate was 6752 tons averaging 65'2% lead, 6'3% zinc, and 30'7 oz. silver. The percentage of recovery of lead and silver has been substantially improved during the last year or two by means of the rearranged mill. There were sold also 36,148 tons of current zinc tailing averaging 14% zinc, 3'5% lead, and 4'8 oz. silver; 22,249 tons of dump tailing averaging 17'8% zinc, 5'2% lead, and 7'4 oz. silver; 7926 tons of mill slime averaging 21'7% zinc, 13'7% lead, and 16 oz. silver; and 889 tons of vanner middling averaging 25'7% zinc, 9'8% lead, and 14'6 oz. silver. The development is now confined to the 615-ft. level and above. The amount of ore disclosed during the half-year was greater than that extracted. The reserve on March 31 was 228,900 tons averaging 11'7% lead, 12'5% zinc, and 8'9 oz. silver. The West lode discovered a year ago has been developed on the 615-ft. level as far as the boundary of the Central mine belonging to the Sulphide Corporation. Ore to the extent of 19,530 tons has been already extracted from this lode, and 52,000 tons is ready for stoping; it is calculated that a further 30,000 tons will be exposed by additional development. Mr. Ward states that



OPEN WORKINGS OF THE SYSSELSKY.

smelters, to the south of Ekaterinburg. Of the mines, the Gumeshevsky is the oldest, and the oxidized ores there have been worked by open-cut for generations. There are also large amounts of oxidized ore on the dumps that are treated by leaching. The other property, the Sysselsky, was opened as recently as 1906. The ore deposits were described in an article in our issue of June 1912, and reference was made to the leaching process in our issue of January 1910. The report for the year ended May 31 shows that 26,532 tons of ore was smelted yielding 1082 tons of copper, and that 80,879 tons of ore and dump material was leached yielding 234 tons of copper. In addition, 3626 tons of cupriforous pyrite was sold for sulphuric acid manufacture containing 4½% copper. At the iron mines, 24,265 tons of ore was raised, averaging 52% metal; and at the smelter and ironworks, 17,937 tons of pig, 16,161 tons of ingot steel, and 9972 tons of manufactured iron were produced. The company also reports a production of 5262 oz. gold and 811 oz.

another new lode has been discovered and is being developed. The accounts for the half-year show an income of £85,156 and a net profit of £17,466. The shareholders received £30,000, partly out of accumulated profit.

Broken Hill Block 14.—The mine belonging to this company is situated between the Proprietary and the British mines, Broken Hill, New South Wales. It has been one of the less successful of the group. The oxidized zone yielded a fair return, but the sulphide ores were not profitable, so that for some years operations were confined to reclaiming oxidized ore from the upper levels. Two years ago, however, the rise in the price of metals and the improvements in concentration methods justified the reopening of the lower levels, and a contract was made with the Junction North company for the purchase of the ore raised. During the half-year ended March 31, the amount of carbonate ore raised was 6513 tons averaging 25.4% lead and 14.9 oz. silver per ton, the tonnage and assays being much the same as in previous periods. The shipments of sulphide ore totalled 17,297 tons averaging 14.64% lead, 9.95% zinc, and 9.84 oz. silver, figures rather lower than during the previous half-year. The manager, F. Voss Smith, is of opinion that the upper levels will continue to yield carbonate ore for some time. The receipts from the sale of ore were £41,582, and the profit was £4245. The sum of £10,000 was distributed as dividend, partly out of accumulated profit.

Block 14 (Torrington).—This company was formed in 1911 as a subsidiary of the Broken Hill Block 14 to acquire the Fielder's Hill wolfram and bismuth property in the northeast of New South Wales. The report now issued, covering the year ended March 31, states that 10 of the stamps were started on July 1913, and a further 10 in January 1914. The amount of ore milled was 14,133 tons having an average assay of 0.47% WO_3 and 0.059% bismuth; 63½ tons of concentrate was produced averaging 67.33 WO_3 and 3.13% bismuth. Askin Nicholas, the manager, records that the percentage of recovery is not more than 65% owing to the sliming of the minerals, so he proposes to erect canvas tables and buddles. The ore reserve is estimated at 70,000 tons, sufficient to occupy the mill for 2 years. The results obtained so far have not confirmed the original expectations as to grade of the ore. The concentrate sold for £6605 and the expenses were £9323. The capital of the company is £150,000, divided into 127,000 ordinary shares and 23,000 preference shares.

Hampden Cloncurry Copper Mines.—This company was formed in 1906 in Melbourne by the Baillieu group for the purpose of acquiring the Hampden and Duchess copper properties, south of Cloncurry, North Queensland. More recently, the Trekelano, McGregor, Pindora, Answer, and other properties have been acquired. At one time it was proposed to amalgamate with the Mount Elliott, but satisfactory terms could not be arranged. After the collapse of these negotiations, it was decided to build a smelting plant instead of sending ore to the Mount Elliott smelter. During the half-year ended February 28 last, the ore raised was: Hampden 10,144 tons averaging 8% copper, Duchess 14,518 tons averaging 15.2%, and Trekelano 453 tons averaging 13.5%. The smelter treated 25,829 tons together with some fluxing ore and custom ore, the total being 33,105 tons. The yield was 3108 tons of blister copper containing 3073 tons of copper, 1022 oz. gold, and 26,172 oz. silver. The accounts show an income of £224,207, and a net profit of £74,147, out of which £70,000 was distributed as dividend, being 20% for the half-year. As regards

development, a large orebody of comparatively low grade was cut in the No. 1 shaft of the Hampden mine at a depth of 450 ft. On the 350-ft. level from the No. 2 shaft, the orebody has been proved to extend 220 ft., varying from 4 to 9 ft. wide, and averaging 10% copper. Development has been done at the other properties without any special results of interest. The reserve at February 28 is reported as follows: Hampden 57,000 tons averaging 7% copper, Duchess 67,000 tons averaging 15%, McGregor 95,000 tons averaging 7%, Trekelano 16,500 tons averaging 12%, Mascotte 2500 tons averaging 17%, and Answer 3000 tons averaging 13%. The branch railway to connect the McGregor group is to be completed in September.

South Kalgurli Consolidated.—This company was formed in March 1913 to amalgamate the South Kalgurli and Hainault companies operating mines on the same orebodies at Kalgoorlie, West Australia. The South Kalgurli mine has been working since 1895, production started in 1900, and small dividends were paid from 1905 to 1912. The Hainault, which was directed from Glasgow, commenced milling in 1901, and paid small dividends in 1905, 1906, 1907, 1908, and 1911. The amalgamation was effected with the object of jointly exploring for further supplies of ore. The report for the 13 months ended March 31 shows that 5036 ft. of development work was done, with indifferent results at first. During the last few months, however, the results have been much more encouraging, at three separate points. In the Main Shaft section, on the south drift, second level, the ore-shoot has been proved to average 6½ dwt. over 5 ft. for a distance of 68 ft. In Morty's section, a drift at the 873-ft. level is in 13 dwt. ore; and on the 1000-ft. level, in the same section, a drift is in 9½ dwt. ore. Further development at these points is now being done. During the period under review, 124,670 tons of ore was raised and treated, yielding gold worth £133,806. The total cost was £127,134, leaving a profit of £6572, out of which £6250 was paid as dividend, being at the rate of 2½ per cent.

Associated Gold Mines of West Australia.—This company was formed in 1894 to acquire the Australia and other leases at Kalgoorlie, West Australia. Dividends were paid from 1898 to 1909, totalling 150% on a capital of £500,000, and subsequently it became necessary to devote the income to the development of ore of lower grade. Dividends of 2½% were paid for the years ended March 31, 1913 and 1914. The report now issued, for the year ended March 31 last, shows that 127,856 tons of ore was raised and treated for a yield of gold worth £152,105, being an extraction of 23s. 9d. per ton. The working cost, including £13,772 development, was £140,638. The shareholders received £12,384, being at the rate of 2½%. The company has a reserve fund of £108,337 invested in first-class securities. D. F. McAulay, the manager, reports the broken ore in reserve at 33,306 tons, and without being able to give definite figures for prospective ore, states that as much ore should be mined during the current year as was raised during the year under review, and that it should be of approximately the same grade. During the year, Malcolm McLaren made an examination, and indicated the boundaries of the barren and favourable rocks. Though there is no hope of finding ore below the 19th level, there is still much ground worth prospecting from this level to the surface. As recorded last year an interest has been acquired in the Keeley mine, south of Cobalt, Ontario. Work at this mine is stated to be progressing satisfactorily. The company has also taken an option on the North Thompson property at Porcupine.

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Scientia non habet inimicum nisi ignorantem.

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❖ REVIEW OF MINING ❖

INTRODUCTORY.—The close of the first month of the war finds London calm and serious. Financial business is practically non-existent, all that is being done is to conserve the position as far as possible. No new business can be done while the moratorium prevails and until the Stock Exchange position has been adjusted. The first shock to the mining industry has passed and arrangements have been made for the continuance of business by British companies operating all over the world. The one dominating factor is the Navy's patrol of the trade-routes. . . The metal exchange is closed, so that trading is confined to the settlement of old accounts; but metal merchants are dealing in a small way through unofficial channels. The closing of the German and Belgian smelters, together with the temporary disorganization of over-seas traffic, has hurt the mining of the base metals, especially zinc, and a little time will be needed for the discovery or development of new outlets for production. The arrangements made for the purchase of gold deposited in local banks within the various mining regions under the British flag is a result of the war that may be perpetuated after it is over. Similar advances on the base-metal output are likely to be arranged. Cyanide requirements have been met. On the whole the position is good. We hope that the production of gold in the Overseas Dominions may be intensified, for this war will be fought with golden bars as much as with leaden bullets. The control of 60% of the gold output of the world, the other 40% being mainly in friendly hands, Russia

and the United States, should prove an important factor in the finance of the critical period.

TRANSVAAL.—While the output of gold in August shows a slight decrease, to £3,024,037 as against £3,111,398 in July, it is fully explained by the temporary disorganization of supplies immediately upon the declaration of war. All such troubles are rectified now. We can predict confidently that the September output will show a gratifying increase, for labour at the mines is plentiful, by reason of the diminution in industrial activity all over South Africa. Moreover, the increasing use of the small machine-drill for stoping has diminished the requirements of native labour at individual mines to such an extent as to decrease the normal complement. All the conditions favour Rand mining at the present time, when a productive gold property is the best asset in the world.

Early in August some of the principal mills on the Rand were handicapped by lack of sufficient zinc, it being easy to obtain ingots but not sheets. This matter was soon adjusted, so that the trouble has now vanished.

By the reduction of operations at the De Beers and Premier diamond mines, where work is proceeding on half-time, it might be supposed that a large accession of natives would be rendered available for the Rand; but this is not the case. The 'boys' employed at Kimberley are Basutos, and they must be repatriated according to agreement. In any case, they would not be likely to accept underground work in large numbers. Meanwhile,

the working of the diamond mines at half-time, in deference to the wishes of the Government, must be regarded as a patriotic, not a business, scheme. No such sale for diamonds exists as to warrant even a production on half the usual scale, so that the gems will have to be stored; which is not profitable.

We are informed that the funds required to complete the plant in course of erection at the Modderfontein Deep are being provided by A. Goerz & Co., and that this work, therefore, is not contingent upon the selling of the 105,500 reserve shares at 35s. per share. Moreover, the main part of the machinery was shipped before hostilities began, so that the mill, it is hoped, will be ready by the end of the current year. It has a capacity of 30,000 tons per month.

RHODESIA.—The July output of gold is the largest hitherto recorded, namely, £320,670, as compared with £249,302 in the corresponding month of last year. The Shamva, with £38,455, and the Cam & Motor, with £15,867, are notable contributors. The number of producers was 232, as against 209 in June, indicating that many small mines became active.

Messrs. F. A. Macquisten and J. E. Howard, two directors of the Globe & Phoenix, cabled on August 19 from the mine that recent developments, particularly between levels No. 19 to 21, are "of great value." They also report that ventilation is now excellent, owing to the connection between the new vertical shaft and the main workings, and they suggest the idea of increasing the monthly profit during the war.

The Bell Reef, a Gold Fields subsidiary, which started crushing in February, is making improved returns. In July 3490 tons was treated for a yield of 43s. 8d. per ton, at a working cost of 32s. per ton. The nominal profit was £2087 for the month.

At the Shamva, the yield improved 15s. 2d. per ton in July, for 50,622 tons of ore. The estimated extraction is not stated, but it was

probably about 86%. The nominal profit was £18,604 for the month.

WEST AFRICA.—In this part of the British Dominions also a record gold output is recorded for July. The yield of £151,923 compares with £132,936 in the corresponding month last year. The Abbontiakoon, Abosso, Broomassie, and Prestea made gains.

It is announced officially that the Colonial Office has arranged for a reduction in the through railway-rate on tin ore in Nigeria, the new rate being 3d. per ton-mile, as against the 5d. heretofore levied. Further, it has been arranged by the Government and the Niger Company, jointly, to reduce the royalty from a minimum of 2% when tin is quoted in London at less than £130 to a maximum of 5% when tin is quoted above £190 per ton. Intermediate figures are 2½, 3, and 4% when tin is £130–135, £135–160, £160–190, respectively, per ton. These reductions go into effect at once and will remain in force until the end of the current year at least. On the strength of this the Niger Company has informed the mining companies that it will reduce the through freight from Bukuru to Liverpool to £13½, as against £22½ formerly. This should prove of great assistance to the mining industry. It only remains for the Government now to make advances on the concentrate produced, as is being done in Cornwall and the Straits Settlements.

Shipments of tin were suspended for a month after the outbreak of war, owing to the commandeering of the railways for the transfer of French troops from the French colonies across Nigeria to the Cameroons. Now, however, the lines are free again, so that shipments have been resumed.

The sections overleaf show the character of bedrock on the Top leases, belonging to the Rayfield company. Mr. J. M. Iles, the manager, says that some of the holes go down over 12 feet in depth, the richest gravel being on the granite bottom. Obviously dredging

is unsuitable; on the other hand pumping extracts the rich sediment without removing unnecessary ground.

CANADA.—A mining excitement has centred around Sesekinika, in Ontario, about 10 miles northwest of Kirkland Lake. Some free gold and tellurides have been found in narrow quartz veins. Prospects are fairly good, but not enough work has been done to justify the prices put on claims. The best find is the Labine, where a vein 4 to 12 inches wide has been stripped for 500 feet. Other small veins have been exposed, but the deepest hole as yet is only down 5 feet; nevertheless as much as \$500,000 is asked for a group of three claims. The Hollinger is looking particularly well. At the 675-ft. level the No. 1. lode is 23 feet wide and of average grade. Owing to the scarcity of cyanide, due to the war, it has been found necessary to modify the treatment, employing amalgamation to an increased extent. The additional 20 stamps have been started, making 60 in all. The Dome, Porcupine Crown, and McIntyre, being self-supporting, are not affected by the war. Underground work has been resumed at the Vipond. At Kirkland Lake, the Tough Oakes has suffered from break-downs in the Charlton electrical power-plant, but these have been repaired. Development work continues with most satisfactory results. At Cobalt the weakness of the silver market has compelled the Kerr Lake, Drummond, Beaver, and Buffalo mines to close-down, while others have reduced their output. The last settlement made by the smelters in July was on the basis of $52\frac{1}{2}$ cents per ounce, or 7c. less than the average price in 1913. The American Smelting & Refining Co. has notified its clients that it will not advance more than 25c. per oz. on its silver purchases, leaving the balance due to be fixed by arbitration when the war is over. This threatened to cause a panic at Cobalt until it was announced that the British government would purchase and pay for all the silver that

was in London. Since then the Canadian government has arranged with the banks for loans to the mining companies on silver bullion.

UNITED STATES.—The copper industry is hard hit. While 40% of the American production is ordinarily consumed at home, the consumption fell in August to a 20% basis. Some mines, like the United Verde, on account of its fire underground, cannot stop, but reduction of output is general. It amounts to a curtailment of 50% in the total production. The Tamarack in Michigan and the Mountain Copper in California have shut-down entirely, the Calumet & Hecla has reduced its output by 60%, Phelps, Dodge & Co., by 25%, and the United Verde by 33%. The Copper Queen company is treating only Miami, Ray, and Cananea concentrate, having closed its own mines.

The American Copper Producers' Association has ceased to publish the usual figures for output, consumption, and stocks. The United States customs department reports the exports of copper for July at 34,145 tons and for August at 19,676 tons.

During the first half of August the prices of metals fluctuated wildly in New York. Tin jumped to 73 cents, antimony to 22 cents, zinc to 6 cents per pound. A scarcity of cyanide is reported, owing to the cessation of imports from Germany. The Röessler & Hasslacher plant at Perth Amboy is to be operated at full capacity and should be able to meet American requirements of cyanide.

From California we learn that the re-organization of the Natomas Consolidated has been accomplished successfully, more than 85% of the first mortgage bonds having been deposited in support of the new scheme. Of the second mortgage bonds, 90% have been deposited.

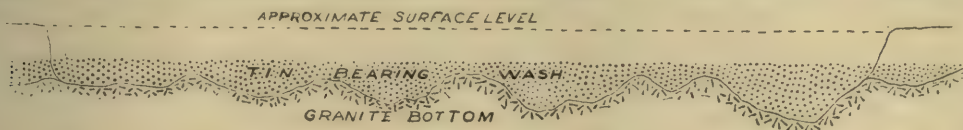
The old Camp Bird mine refuses to be exhausted. In July this Colorado property gave a profit of £11,896, which was particularly acceptable at a time when the company's

Mexican mine, the Santa Gertrudis, at Pa-chuca, was crippled by the political disorders.

AUSTRALASIA.—The New Chum Gold-fields, a Bendigo company, worked during its last year at a total cost of 10s. 4d. per ton, to a depth of 1176 feet. The yield of gold was £26,570, from which £17,600 was paid in dividends and £1018 carried forward. The report states that "the installation of ore-breakers and self-feeders will make for

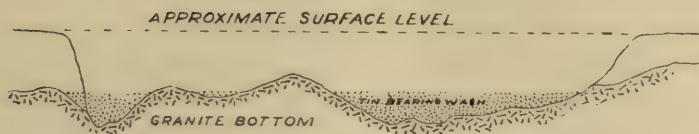
this level has been exceeded twice at times of special clean-up. It is notable that the yield at the Jibutil in the Anantapur district is beginning to grow, being 750 ounces in August as compared with 540 ounces in July.

MEXICO.—It appears that the Carranza party is now well established in Mexico City. President Carbahal cleared out, going to Vera Cruz, so that the final transfer of government was made by Señor Eduardo Iturbide, Gov-



Longitudinal Section

Scale of Feet



Cross Section

ILLUSTRATING CHARACTER OF BEDROCK ON TOP LEASE, NORTHERN NIGERIA.

economy." Feeding by hand, during the previous six months, cost 5d. per ton. Evidently, Mr. W. J. Rickard, the manager, is to be congratulated on having overcome local ignorance, at last.

The official figures for the production of gold in New Zealand are based on the amount declared for export. Consequently the returns for August are low, being only £12,876, just one-tenth of the average monthly output during the preceding seven months. Without this explanation, some of our readers might interpret the figures to mean a sudden collapse of the gold-mining industry of the Dominion. The war has curtailed export, that is all.

INDIA.—The output at the Indian gold mines was fully maintained during July and August. The total figures for both months were over 50,000 bullion ounces, and constitute records for current production, though

ernor of the Federal District, the one big man of the moment. Villa and his troops are at Chihuahua, and it remains uncertain what he intends to do. The new government has cancelled the concessions granted by Huerta, but it is claimed that this does not imply the general repudiation of national obligations. The National Bank of Mexico and other leading financial institutions have re-opened their offices for business. Huerta has passed through London on his way to Spain.

RUSSIA.—Mr. R. Gilman Brown returned on August 22 from Siberia and the Ural region, bringing relatively good news concerning operations at the Kyshtim, Tanalyk, and Russo-Asiatic properties. From 30 to 40% of the working force has been withdrawn from the mines for military service, but this has necessitated only the cessation of development and construction, not active production. It is ex-

pected that an output of 500 tons of electrolytic copper can be made monthly by the Kyshtim, and can be sold to advantage. The Russian government is a willing purchaser of copper on the basis of a London quotation of £75, this figure being £10 higher than that obtaining before the outbreak of war, but fixed there owing to the cessation of imports; therefore, including the bounty, or import tax, fully £100 nett will be paid to the producers. At the Tanalyk the first furnace was started in the spring in advance of the rest of the plant, which is to be finished this month, so that one furnace can be kept going. At the Ridder mine, of the Russo-Asiatic Corporation, the nomadic Kirghiz are largely employed, these being not subject to mobilization. Prospecting and development work continue uninterrupted both at the Ridder and at the Ekibastus coal mine. The experimental concentration plant at the Ridder is running now. Prospecting operations have been generally successful, not one of the seven bores having drawn a blank. The war, however, will delay the erection of the first unit in the ore reduction plant. Diamond-drills are also at work on this company's Nerchinsk concession.

In the Bodaibo district one fourth of the labour supply has been drawn to the war, but it is believed that the Lena Goldfields output of gold will be about the same as last year, owing to some recent rich discoveries, which will compensate for the decrease in yardage.

CORNWALL.—No public sale of tin concentrate has taken place since July 20, the date of the last ticketing at Redruth. On three occasions the mines refused the bids of the smelters. By their inability to dispose of their products, many mines have been hard pressed for funds. The firm of Bolitho has come to their rescue by offering loans up to 60% of the value of the concentrate, the value being based on the minimum price of the metal as fixed by the London metal exchange. The Dolcoath report and meeting simply

confirm the forecast made in this Magazine in February last year. We say it with no pleasure. During the last half-year the profit earned was the smallest in the history of the enterprise, that is, since 1895, when the limited liability company superseded the cost-book undertaking. The yield of black tin has declined from 79 pounds per ton of ore crushed in the first half of 1895 to 28½ pounds in the corresponding period of 1914. The particulars given in the report concerning the deeper exploratory work are most depressing. The ore that had been found proves to be in small patches of no consequence. We record the death of Mr. Gilbert Pearce, one of the directors, after an operation for appendicitis, which, owing to his advanced age, proved fatal. He will be widely regretted. The resignation of the secretary, Mr. F. W. Thomas, has nothing to do with the company's gloomy position, but is due to the offer of an important appointment with Williams, Harvey & Co.

METALS.—The London metal market is still utterly disorganized, and the Exchange is closed except for the settlement of old accounts and the arrangement of minimum prices. The sales of silver are confined to coinage requirements, and the nominal price is 24d. per oz. standard. The provisional quotation for standard copper is £60 per ton, and for electrolytic £62. Lead has changed hands at prices between £18. 10s. and £20. 10s., and zinc is nominally at £29. At the Banca sale at the end of August, 1100 tons of tin brought £157 per ton; the official minimum on the Exchange is £135. Antimony has advanced by £5 to £37 per ton. Aluminium is £10 higher at £90, and nickel £20 higher at £190. The prices of iron and steel remain substantially the same as they were before the war. We do not publish our usual page devoted to Metal Markets. We have also omitted our Statistics of Production owing to the incomplete nature of many of the tables.



EDITORIAL

Moratorium te Salutamus.

FRANCISCO VILLA, in a published interview, condemns the German outrages in Belgium. Victoriano Huerta, presumably, thinks himself a gentle soul and Mexico a highly civilized country—by comparison.

HAVING been through the San Francisco earthquake-fire, for example, we warn manufacturers of machinery and supplies not to take advantage of the necessitous condition of their customers by raising their prices. Such hold-ups defeat their purpose, for the present gain is obtained at the expense of future business, and of a good name.

OUR COMPLIMENTS to the editor of the *Etoile Belge* at Brussels. He refused to surrender his presses and, rather than see them used for the publication of a German military bulletin, he damaged them completely. May the *Etoile* rise again to shine in a happier sky and a better day.

PREPARATION for military service is a patriotic duty, even among those not eligible for the army at the present time. We are glad to state that Mr. Walter Broadbridge, captain, National Reserve, has organized a corps for company and musketry drill; this undergoes instruction in a large hall in Salisbury House the use of which is due to the public spirit of Sir Sigmund Neumann. One company has been formed, and a second is being recruited. Drilling begins at 4 and lasts until 8 o'clock in the evening, and from

11 a.m. to 1 p.m. on Saturdays. A number of mining engineers are enrolled. Others will be glad to know of this opportunity to obtain military training.

CONGRATULATIONS to Sir George Paish, editor of *The Statist*, on being called to assist the Treasury by his experience and sagacity. The appointment is a compliment to financial journalism and evidence of the intention of the Government to utilize any ability that can assist the country in this great crisis of her fate.

ON the West Coast of Africa the incidence of war caused a mild panic, owing to uncertainty as to food and finance. This was the case in many distant mining regions, especially those dependent for food on sea-borne traffic. As soon as the trade-routes were safeguarded by the British navy, the anxiety vanished.

BECAUSE of the war, the committee to promote British participation in the Panama Exposition has been dissolved, but it is announced that the Exposition will open on February 20 and close on December 4, as previously arranged. Surely, if efforts are to be made to capture German trade, it is incumbent upon our manufacturers to make the most of the opportunity afforded at San Francisco.

THE ACCENT in Liege may be acute or grave according to taste. Cassell's French dictionary, Collins's 'Authors and Printers Dictionary,' Lippincott's Gazetteer,

and a number of editors make it Liège; Charles Beranger, the publisher, of Paris and Liège, gives Liège; so does *The Times*; so do we. The post-mark omits the accent. In whatever way we spell it, we pronounce it GOOD.

AT a time when Europe was retrograding into the barbarism of organized murder, a grand work of peace was inaugurated by the opening of the Panama Canal. This great event was signalized on August 15 by the passage of the *Ancon* through the new waterway from the Atlantic to the Pacific ocean. The *Ancon* is a steamer of the American War Department. She went through the Gatun locks in 70 minutes, being followed by several other vessels. The Canal is now open to vessels drawing not more than 30 feet of water.

DIAMOND imports furnish a good barometer of national prosperity. Undoubtedly the decrease of American imports of precious stones is significant. Up to August 27 the total was \$16,337,000, as against \$33,333,000 during the same period last year. During the first four weeks of August the importation of diamonds fell to \$1,845,000, as compared with \$3,999,000 during the corresponding weeks of August 1913.

ON THE DAY that mobilization began in Russia, the sale of vodka, wine, and beer was stopped by the Government everywhere except in first-class hotels. It is a pity it was not stopped there also. The drink monopoly gives Russia a revenue of £80,000,000 per annum, being the largest item in the national budget. This has been sacrificed, and much more besides, in the cause against the enemy. Engineers returning from Russia report the soldiers as tremendously keen. Twelve million uniforms are said to have been made ready for use. The need for mechanics and engineers had caused a severe drain in the

mechanical departments of the big copper companies.

NITRIC ACID is the prime necessity for the manufacture of the explosives used in war. Germany has always been a large importer of Chile nitrate, much of which has been used in the production of acid. With her ocean traffic stopped, she will have to depend on the synthetic processes of Birkeland-Eyde and Ostwald, whereby nitric acid is produced directly or indirectly from the nitrogen of the air. These methods of producing nitric acid hitherto have not been received favourably by manufacturers of explosives, owing to the cost and the difficulty of preparing the acid in an anhydrous form. But with supplies of nitrate unavailable, and in a time of vital stress, the comparative cost will not be considered, and the German hydro-electric stations will be commanded to supply all the acid required.

GOLD, more than lead, is the metal most important in war. General Montecucoli informed Maria Theresa that three things were necessary for making war: the first was money, the second money, and the third was money. In time of war only the ultimate standard of money, namely gold, is recognized. We are glad to state that the British Government has arranged with the Bank of England for the purchase of gold from the mines as soon as it is deposited in accredited local banks. This applies at once to the mines in the Transvaal and in India, and it will be applied similarly to every gold-mining region under the British flag, that is, to 60% of the world's total gold output. The mining companies in London will be paid about 97½% of the gold value on its deposit at the local bank, so that cheques and remittances can be drawn against it forthwith. This facilitates the continuance of operations and secures the gold for the Bank of England, whence it is distributed in accord

with commercial requirements, which, in time of war, are mainly domestic.

CYANIDE SUPPLIES are now assured for the Rand and the Indian mines, and will be available for gold mines generally at an early date. The Cassel Cyanide Company is the chief manufacturer in this country. Complaints have been made against the rise in price, from about 7 to $8\frac{1}{2}$ pence per pound for 100% cyanide, this 20% increase being deemed excessive. As against such complaints it must be noted that the South African and other mining houses have contracts with German firms, all of which contracts, although 'avoided' now, by law, may become operative again, by international law, as soon as peace is declared. Therefore the British cyanide manufacturer engages to supply more cyanide, and to increase his plant for that purpose, without any guarantee that he can hold his market, but with the suggestion that he will be preferred after the war, so far as the law may allow. This factor remains uncertain for lack of modern precedents. It is claimed that British firms were largely shut out of the market by German under-cutting, but the Cassel company pays 3s. 6d. per annum on a 5s. share, so it does not appear to have suffered grievously. The fact is that the manufacture of cyanide has been largely controlled by an international ring, the disintegration of which would be a great boon to the gold-mining industry.

ELSEWHERE we give the general regulations applying to business with enemy aliens. As an example of cases arising under existing conditions, we refer our readers to the question asked by Mr. W. Joynson-Hicks in Parliament on August 31. He cited facts to show that practically all the shares in the Siemens Dynamo Works, Ltd., were held by Germans in Germany, and yet the Government had a contract with the firm for the sup-

ply of electric lamps for the ensuing twelve months. The President of the Board of Trade, Mr. Walter Runciman, replied that the general question of the position of limited companies controlled by alien enemies was receiving the most careful consideration of His Majesty's Government. We are aware also that the Admiralty was invited to seize the Swansea Vale zinc plant controlled by Aron Hirsch und Sohn, of Halberstadt in Germany, but ascertaining that it was operated in the name of a company registered in England, the reply was in the negative.

WE take pleasure in publishing the latest information concerning the use of coal-dust as a fuel in reverberatory smelting practice at Anaconda. The article is by Mr. E. J. Carlyle, who returned recently from America and is now on his way to the Ural region. As many of our readers are aware, during recent years the competition between the blast-furnace and the reverberatory, particularly in copper smelting, has been keen. The development of the big blast-furnace, as first put into effect also at Anaconda, made possible not only greater capacity in the furnace itself but gave an elastic unit, for one part of the furnace may be under repair, or out of use, without detriment to the remaining portion. It also furthered economy in fuel, previously promoted by the use of the blast-furnace for pyrite smelting, in which the oxidation of the iron sulphide furnishes heat-units that replace coke in the smelting operation. Indeed, fuel economy has been the successful aim in the use of both types of furnace. The new design of blast-furnace seemed to achieve this purpose best as applied to coarse material, to such a degree in some cases as to warrant briquetting or sintering of the fine. Now, however, the experimental work so successfully accomplished at Anaconda suggests that conditions may arise when it may prove economical even to crush ore to a size con-

venient for smelting in a reverberatory furnace, after roasting, when roasting is necessary. The results outlined by Mr. Carlyle indicate that an increase of fully 20,000 tons of copper per annum can be made at Anaconda owing to the improved recovery, without any increase of cost and without treating more ore. The war, of course, will postpone the achievement, as it has postponed many other pleasant things, but the technical accomplishment is one that Mr. E. P. Mathewson may already put to his score, previously notable in its metallurgical successes. We violate no confidence in saying that Mr. Carlyle came from studying this new departure at Anaconda with an enthusiastic appreciation of the admirable spirit that pervades the staff at that great smelting establishment. There the cordial co-operation of experience and science, in the persons of men of various abilities, is strikingly manifest. A belief in the reciprocity of ideas as between themselves and those working at other plants has contributed to the application of the best knowledge extant. This free trade in knowledge is remarked by visitors, many of whom have taken pains to inform us of the courtesy and liberality accorded to them on the occasion of *voyages metallurgiques* through the United States. It is impossible to measure the value of the assistance thus given to those engaged in copper smelting in other parts of the world. For them, and for the industry, we take this opportunity to thank Mr. Mathewson and the exceptionally able staff at Anaconda.

CONTRIBUTIONS to the National Relief Fund include many made by mining companies and their directors. The Indian gold mines, as usual, have led the way in subscribing to public subscriptions, the Mysore giving £2100, the Champion Reef £1050, and the Ooregum and Nundydroog £525 each, the odd figures being due to the use of the guinea unit. The engineering firm of John Taylor &

Sons donated £500. Among the South African houses, the Central Mining contributed £1050, Mr. Otto Beit £5000, Sir Lionel Phillips £500, and Mr. F. Eckstein £1000, Village Main Reef £500, the Consolidated Gold Fields £1000, Barnato Brothers £1050, S. Neumann & Co. £500, Sir Sigmund Neumann £1000, Sir George Farrar £500. Australian ventures are represented by the Zinc Corporation, Ivanhoe, Lake View & Oroya, and the Lake View & Star, each of which sent £250, while the Great Boulder Proprietary subscribed £500. Others deserving honourable mention are: The Chinese Engineering & Mining £1050, Wankie Colliery £525, Mond Nickel £1000, S. Pearson & Son £2000, Johnson, Matthey & Co. £1000, Morgan Crucible Co. £500, Mr. T. R. Bolitho £500, and Sir Robert Hadfield £10,000. The Globe & Phoenix subscribed £250 to the Belgian Relief fund. We note with pleasure the large number of handsome subscriptions from gentlemen having German names, and we say frankly that this outward and visible sign of their loyalty to the country of their adoption is keenly appreciated. Indeed, the Beits and Ecksteins, of the Corner House, have ever been strongly and sincerely British, giving not only money but their sons to the support of the flag.

A Scrap of Paper.

It is now a matter of history that Sir Edward Grey, on behalf of Great Britain, warned the German government that the violation of Belgium's neutrality, as guaranteed by treaty, would lead to war between Great Britain and Germany. This message was conveyed on August 3 to Herr Von Bethmann Hollweg, the German Chancellor, by Sir Edward Goschen, the British Ambassador at Berlin. On that occasion the Chancellor expressed irritation that Great Britain should adopt such an unreasonable attitude: he called it going to war "for a scrap of paper." Whereupon our Ambassador informed him

that England's name—not to mention Germany's—was on the scrap of paper and for that reason it was regarded as a solemn compact. The Chancellor had the effrontery to inquire whether we had considered the cost of keeping faith with Belgium. No; we did not count the cost, nor shall we, but we intend to fight to the last ditch for our honour and the public law of Europe. Herr Von Jagow, the Chancellor's assistant, explained earnestly to Sir Edward Goschen how absolutely necessary it was for Germany to advance into France by the quickest and easiest way so as to strike a decisive blow at the earliest possible date. It was a matter of life and death to them. That was the justification: the law of necessity. Belgium's or France's rights in the matter were as dust in the whirlwind of Prussian aggression. To most of us the mental attitude of the German diplomats is at least as astounding as the scrupulousness of Sir Edward Grey appeared to Herr Von Bethmann Hollweg. A scrap of paper, forsooth; Magna Charta, the Bill of Rights, and the Hay-Pauncefote treaty are scraps of paper for which the English-speaking peoples have a curious respect. Even if we are rather stupid folk—not quite educated to the fine points of Germanic culture—we consider it wrong to violate contracts of any kind. Our daily dealings are largely governed by an old-fashioned respect for agreements written and unwritten. We have not yet grasped the sublimity of conduct based on a disregard for honourable obligations. It will remain for William the Hun and his hordes to teach us the new way of playing the game. Such things are done, it is true; in parts of the world considered less cultured than Berlin and Leipzig. Among the ruffians of the Mexican border it is not unusual for the loser in a game of poker to draw a pistol and settle his account by shooting his opponent before the latter can defend himself. But even at Nogales and Juarez such performances are not considered

in the best form. Even there scraps of paper are considered not wholly negligible. On race-courses there are professional gentlemen called bookmakers, who register verbal bets with their clients and pay their losses like men. Should they go back on their word, they are called 'welshers.' But then neither these bookmakers nor the gentlemen on the Rio Grande have read the literature of real culture, as expounded by Nietzsche, Treitschke, Mommsen, Von Bernhardi, and sundry other distinguished professors. The simpletons who live so far from Charlottenburg have no conception of "the bold flights of German genius," nor of the proper value of "German world citizenship"—to quote Von Bernhardi. This exponent of the Germanic idea considers that "England committed the unpardonable blunder of not supporting the Southern States in the American War of Secession," for by failing to do so she allowed "a rival to appear on the other side of the Atlantic." According to this chivalrous gentleman England should have taken advantage of America's distress so as to smash her once and for all. Yes, we were stupid. We are unfit for world-wide dominion. We lack the "will-to-power" and the true appreciation of the gladiatorial theory of life. Of course, being merely the suburbanites of creation we thought that the ethical idea had eradicated the ape and tiger in man. Not at all; that was the ignorance of people who had not graduated at the University of Berlin. At that centre of real enlightenment such Sunday-school notions are regarded as excavated anachronisms; there it is recognized that the true code is the law of necessity, the ferocity of Attila, the fanaticism of the Mad Mullah, the instinct of the burglar, and the chivalry of a cheat. *Aut vi aut fraude*, that is the motto of the Hohenzollern; that is the gospel of the Teutonic culture which sneers at the ideals of John Hampden, John Bright, and Abraham Lincoln. At any rate

the Prussian evangel has been preached loudly enough; we thought it the vapourings of a clique of military monomaniacs; we heard the Potsdam War-Lord's blasphemous utterances and thought them the expressions of a queer genius; we read the writings of professors that taught brigandage as if it were a fine art, but we regarded them as paranoiacs. We see now that we were wrong. Each and all of them, from Nietzsche and Treitschke to Wilhelm Hohenzollern and Bethmann Hollweg were deeply in earnest, enthusiastically determined, and consistently intelligent in the perpetration of a crime so great that only one greater has ever been perpetrated on earth. They have sent European civilization to the shambles. They have hurled millions of in-offensive peasants and workers at each other's throats. They have invaded a peaceful little country that had no part in any of their quarrels, and they have devastated, destroyed, and sacked it, from end to end. At last we realize their purpose, we know their methods; we foresee the fate in store for those that are in the way of the diseased ambition of the Prussian military machine and its academic sponsors. There is no defence but the sword. No court of appeal remains, for the judges themselves are fighting. All the Great Powers are on the war path. There remains no power on earth to discipline the belligerents. Across the Atlantic there is a friendly observer, it is true, but he expects to remain detached, and in any case he is not sufficiently armed to interfere between such ferocious antagonists. Later, he may exert a useful influence. Now he thinks, as we did, to keep himself in splendid isolation. So the fight must be fought to a finish. A new Napoleonism, without Napoleon, is threatening to destroy the liberties of Europe. As of old all the resources of a free people must be thrown on the side of human liberty, all the youth of a world-wide empire must rally to the fight against imperial ambition and tyrannical militarism. It may be a

long fight; it may be a hard fight; but in the end that scrap of paper shall be made good by the great defaulter, and into the waste-paper basket of dishonoured statesmanship shall be thrown the wanton infraction of the treaty that guaranteed the inviolability of a little country and the independence of a courageous people.

Teutophobia.

A few days after the outbreak of war, an effort was made to use the natural prejudice against everything German as a lever for attacking the South African financiers and mine operators having German names. We yield to none in our hatred of the Prussian military bureaucracy, and we abhor the megalomania that is the motive power behind this hideous war. As for patriotism, no man should boast of it; we shall not. Suffice it to say that while we hope with all our heart that the German armies may be utterly beaten, we refuse to intensify the present European relapse into barbarism by treating every man with a German name as if he were a leper. The in-humanities incidental to war are bad enough without our trying to make them worse. The prejudice against everything German will be keen enough after the war without educated men fanning the flame into a social conflagration. And who are they that want to eject every man with a German name from the boards of South African companies? Are they likely to conduct affairs with greater sagacity or greater success? We think it most unlikely; not that the big houses under discussion are filled by sunday-school teachers or Admirable Crichtons, on the contrary, we have had good reason to question their motives and to criticize their actions on occasion; but the Teutophobes on the war-path have a record that will bear no examination. Moreover, how are we to distinguish between genuine Englishmen, born and educated in England, with an inheritance of German

names, and those who are essentially Germans in mind and heart, even though naturalized? It is well to go slowly, for fear of doing a cruel wrong to individuals and a real dis-service to the mining industry. We bracket Alfred Beit with Cecil Rhodes, Sir George Albu with Lord Harris, Mr. Raymond W. Schumacher with Mr. A. R. Stephenson in equal honour. For naturalization we have no respect or recognition, as we explain elsewhere. It furnishes no adequate test of a man's loyalty to the country of his adoption. We shall not be surprised if, as a matter of good taste, the mining groups decrease the number of directors with German names, retaining those that have given proof of their alienation from Prussian militarism, but this can be done in good time and in a civilized way, not by evoking a black cloud of ignorant spite against people to whom this war must be as great a catastrophe as it is to any of us.

Zinc Smelting.

Among the industries most immediately affected by the war is the smelting of zinc ore and concentrate, particularly the latter. The consumption of zinc in Great Britain is at the rate of nearly 200,000 tons per annum, the domestic production is 55,000 tons, and the importation 145,000 tons. Moreover, domestic production of the metal is derived almost entirely from the treatment of ore mined outside the Kingdom. Only 17,000 tons of zinc concentrate, yielding about 6000 tons of spelter, is produced annually in Great Britain. Nevertheless, zinc is a metal essential to a civilized country, for it is the component, with copper, of brass and its various derivative alloys, as well the coating of galvanized iron. The chief source of zinc under the British flag is Broken Hill, an Australian mining district that produces 200,000 tons of zinc per annum, mainly in the form of a zinc-lead concentrate. Such material is not wanted by the four or five zinc smelters established in

Britain, for they confine their small-scale operations to the reduction of high-grade zinc ore, chiefly calamine. Only one smelter treats Broken Hill concentrate. The annual output of zinc concentrate at Broken Hill is 525,000 tons, containing 45% zinc, which corresponds to a production of metal exactly equivalent to our domestic consumption. Most of this concentrate goes to Belgium and to Germany. In both regions the war has put an end, temporarily, to smelting operations. It is desirable to take advantage of existing conditions to render Britain less dependent on outside sources of supply and to divert shipments of Broken Hill concentrate from the German plants to works within our own borders.

Zinc metal was first produced at Bristol in the early part of the 18th century. For twenty centuries before that the zinc alloys of copper were made directly from zinc ores by cementation with copper. The metal itself was not known, only the physical changes made in copper by smelting it with zinc earths. The art of extracting zinc from its ores was introduced from the East, China and India. This is commemorated by the synonym 'spelter,' which is derived from *spiauter*, a term borrowed from India in the 16th century. But zinc smelting on a large scale in Europe dates only from the first years of the 19th century, when the distillation process was borrowed from England and applied to the treatment of the ore deposits in Belgium. The Liège smelting industry was based upon the proximity of large deposits of calamine, the continuation of which eastward also supplied the smelters in Rhenish Prussia. At about the same time South Wales and Silesia independently became centres of zinc production. Silesia adjoins Russian Poland and Austrian Galicia, into both of which smaller portions of the Silesian zinc deposits extend. At Swansea, the Welsh smelting centre, the production of zinc was conducted as an adjunct to the smelting of copper, for making brass.

In the early days the copper ore came mainly from Cornwall and the zinc ore from various parts of the British Isles, notably Flint and Cumberland. The Welsh smelters are still manufacturers of the final copper products, sheets, tubes, and wire, as well as of ingots and their various alloys, but with the exhaustion of the domestic supply of ore, and the establishment of smelters at mines abroad, the copper-smelting business of Swansea is almost dead. The plants that have rolling-mills, namely, Vivian & Sons and Williams, Foster & Co., now buy copper ingots instead of ore, and their zinc works produce spelter for their own requirements in the manufacture of brass alloys and for occasional sale to others. The zinc-smelting industry in South Wales cannot be called decadent, but it has failed entirely to expand on any such lines as those characterizing modern developments in Belgium and Germany; it is limited to the reduction of calamine and the treatment of zinc by-products; therefore it is of no use to the great mines at Broken Hill, the chief British source of the metal. On the other hand, the Belgian and Rhenish smelters depend mainly on the supply coming to them from foreign sources.

As regards the reduction of zinc ores, the metallurgical problem differs from that involved in the extraction of other metals in that the temperature of dissociation of the oxide is above the boiling point of the metal. Therefore, the operation is one of distillation, not ordinary smelting. The conditions under which the zinc vapour can be liquified and solidified are such that no method has as yet been discovered for conducting the reduction on a large scale. A zinc furnace, however big, is composed of a number of units of limited size; the largest have a capacity of 120 pounds of ore. This entails the employment of much labour. At the three European centres of the industry the retorts differ in shape, size, and method of heating. The Belgian retort has the largest output, so that it is

superseding the other forms. It is clear that the prime requisite in the zinc-distillation process anywhere is a plentiful supply of skilled labour of the right kind, and, seeing that the metal is low-priced, such labour must also be cheap. This explains the fact that the raw material is still drawn from distant parts of the world to the old smelting centres of Europe and that it has been impossible to found a zinc-smelting industry in Australia. As regards the American part of the subject, we are glad to refer our readers to a peculiarly timely and trustworthy series of articles by Mr. E. H. Leslie in the *Mining and Scientific Press*. In these articles will be found such a detailed description of modern American practice as must prove of the greatest value to anybody interested in projects to start zinc-smelting in Great Britain.

At the present time there are five zinc-smelting establishments in the Swansea district, namely, Vivian & Sons, Williams, Foster & Co., the English Crown Spelter Co., Dillwyn & Co., and the Swansea Vale Spelter Co. The Vivians have extensive interests in zinc mines in North Africa. The Williams-Foster company has an English management, but the control is held by Henry R. Merton & Co., and the Metallurgische Gesellschaft of Frankfurt-am-Main. When this control was obtained, eight years ago, a new plant of Belgian design was erected. At that time also a dominant share was acquired in Dillwyn & Co. The English Crown Spelter treats ore from its own mine in northern Italy and also purchases calamine to a small extent in the open market. The Swansea Vale smelter was purchased a little over a year ago by Aron Hirsch und Sohn, of Halberstadt, Germany, and new plant has been built. The chief characteristic of all these smelters about Swansea is that they treat zinc ore comparatively free from lead, so that scarcely any concentrate of the complex-sulphide type finds a market there. The only zinc-ore smelter in

Great Britain outside Swansea is the Central Zinc plant at Seaton Carew, in Durham, erected seven years ago by the Sulphide Corporation for the purpose of treating concentrate from the Central mine at Broken Hill. This venture was handicapped by the lack of inexpensive labour of the right kind, so that the plant is one quarter of that originally planned. The establishment of the works in that part of England was thought to be a blunder. Experiments had been made in South Wales and negotiations were commenced for the acquisition of a site on Swansea bay, but some difficulty arose in the transfer of the land, and while the Sulphide Corporation was faced with this *impasse*, a North-Eastern Railway manager, Mr. E. C. Geddes, suggested the Tees estuary. Thereupon the Seaton Carew site was selected on the recommendation of Mr. H. M. Ridge, who, by the way, has just come through the German lines from Dusseldorf. It is close to Middlesbrough and Newcastle, in the centre of a large industrial population and close to a market for brass and galvanized iron.

The Broken Hill mines now need other smelting facilities. It is impossible to erect works on the spot, because cheap skilled labour is unobtainable. The Proprietary Company's venture at Port Pirie has proved as unsatisfactory as that of the Central Zinc Company, and less than one-fifth of the Proprietary's zinc material is reduced in Australia. When the Zinc Corporation was formed in 1905 the intention was to erect a smelter, and Mr. A. L. Queneau, now in the French cavalry, was engaged to advise on the metallurgy. An offer was made for the Cwm Avon works of the Rio Tinto, at the entrance to the Rhondda valley on Swansea bay, these works being abandoned by the Rio Tinto company on the completion of their new establishment on tide-water at Port Talbot. However, the early difficulties with the flotation process and the subsequent financial troubles combined to

compel a postponement of the plans to start zinc-smelting in Britain. Recent events have caused the scheme to be resuscitated. We are in a position to state that the Zinc Corporation, in conjunction with the Burma Corporation, but without the association of any other Broken Hill companies, is making arrangements to erect a plant. Mr. T. J. Hoover is in America to secure the necessary skilled labour, which is readily obtainable owing to the prevailing depression in the zinc regions of Missouri and Oklahoma. American workmen and Belgian also, we are glad to add, have been engaged. We should all like to see many of the brave people of the little kingdom obtaining employment at this time. As for money, we understand that the leaders of the galvanized iron industry are eager to see zinc-smelting firmly established in this country and are prepared to furnish capital, a sufficient amount of which, however, is already at the disposal of the Zinc Corporation as soon as the moratorium is lifted. As to the site, the choice of South Wales would seem to be indicated by the move made by Aron Hirsch und Sohn, who went to Swansea instead of expanding their German works, but this is less important than it seems, for the German firm in question treats calamine, and some blende, but not zinc-lead concentrate. At present the Broken Hill output comes as a part cargo with wool, which is usually discharged first at the Continental ports and at London or Hull on the east coast, so that a western site necessitates trans-shipment across England. These considerations may count. Cheap labour and fuel, plus immunity from fume restrictions, are essential; and we do not doubt that they will be available in several localities. The cost of a zinc smelter is about £40 per ton of spelter produced per annum. Enlargement of plant proceeds by fixed units, so that increase of capacity does not assure proportionate diminution of cost. On the other hand, a business tie between important

zinc-mining companies abroad and a smelter in Britain should be mutually satisfactory and should in the long run contribute materially to the stability of an important branch of the mining industry for which London has furnished, and will continue to furnish, the capital. So far, this zinc-smelting enterprise is the most important industrial result of the savagery of war.

Business with Enemy Aliens.

Recent events have brought home the brutalities of war, in so far as we are compelled to regard pleasant people with whom we have been glad to do business as enemies of our country. All the advertisements of German and Austrian firms were omitted from our last issue. According to the King's proclamation it is illegal to do business with the enemy. When we undertook to send a polite message to the London agents of the German firms, we found that their telephones had been disconnected, by official order. Naturally, the operation of the law is not simple, for it endeavours to regulate conditions complicated by previous international amenities. It is difficult to revert suddenly from civilization to barbarism. Speaking generally, nothing must be done that is helpful to the enemy. Therefore, on no account must payments be made to enemy aliens, that is, aliens in the enemy's country, or even to our nationals resident there, for money sent to the latter will stay there, for the use, directly or indirectly, of the enemy. As regards dividends, the official instructions are that no payment must be made to shareholders having a German or an Austrian address. Shareholders having an address in England should be paid whether their names are English or foreign. For this purpose English people residing in Germany or Austria are to be treated exactly in the same way as Germans residing in Germany; payment of dividends that would otherwise be due to them is suspended until the de-

claration of peace. The amounts due should be placed to a separate account in a bank until hostilities end. This should be done even when such shareholders residing in an enemy country have given instructions to pay their dividends into an English bank or into the London office of a German bank; all such instructions are rendered inoperative by the outbreak of war. The sums will be lodged, presumably, to the 'Unpaid Dividends' account already open in the ledgers of most mining companies. These regulations are obvious, except as to payments to Germans in England; such persons, it would seem, could remit the money to their own country through the neutral channels afforded, for example, by Dutch and Danish banks. At first some of the banks in London refused to honour cheques for customers with German-sounding names, but this was soon corrected. It is to the national interest that those doing business in Great Britain, no matter how their names are spelled, should be enabled to pay the wages of workmen and meet their current obligations. In the case of alien enemies who have received a license to reside here, whether expressed or by implication, the general consensus of opinion is that they are to be treated on the same footing as British subjects, but this must not be taken to include alien enemies who have been interned. The difficulty thus presented can be overcome easily by obtaining a list of alien prisoners from the police. It is believed that alien enemies who have conformed to the regulations of the new Registration Act need no longer obtain an express license from the Crown, but have received by implication a license to reside during good behaviour. This, however, is always subject to alteration in accord with the exigencies of military necessity.

Another interesting point relates to limited companies formed in this country by Germans who still hold all the shares therein. Good legal opinion asserts that a company incorpor-

ated under British law enjoys the position of a British subject, no matter who the shareholders may be. However, so long as the war continues, the shareholders in Germany cannot receive any of the profits, and any German happening to be a director at the outbreak of war is at once rendered incapable of exercising his duties on the board. Nevertheless, it is commonly held that a third party dealing with a company of this kind is not entitled to repudiate his obligation on account of the alleged enemy character of such a company. This cannot, however, be accepted in its entirety, as, judging by the light of the numerous income-tax decisions, if it be apparent that the whole or the main control and administration of the company is in Germany or Austria, the *centre de l'entreprise* is abroad, and the company, notwithstanding its British legal domicile, is in effect a foreign corporation and should therefore be regarded as an alien enemy.

As regards contracts in general, all those made with persons in the enemy's country before the declaration of the war are suspended or, if executory, avoided; all contracts made after the declaration of war are illegal and void, even with our own nationals resident there. Where the due performance of obligations necessitates dealing with an alien enemy during time of war, the contract may be considered as absolutely void; otherwise, the execution of the contract may be suspended until such time as peace supervenes. The legal rights and remedies of an alien enemy in respect of debts due to him in Great Britain are suspended during hostilities; but they are revived on the conclusion of peace. It is not the nationality but the place of residence that is the criterion of enemy character. No objection is made officially to trading with German or Austrian firms established in neutral or in British territory. If a firm in hostile territory has a branch in neutral or British territory, it is permissible to do busi-

ness *bonâ fide* with that branch, so long as no transaction with the head office is involved during time of war. Sterner regulations or special prohibitions may be imposed by the Government in case of need.

It is to be assumed that all the legal restrictions and official instructions will be interpreted with a view to two purposes: to avoid assisting the enemy in any respect whatever, and to be prepared to deal honourably with him when hostilities cease. War is a disease, caused by the insincerities of diplomats and the megalomania of chancellors; it must be treated as a lapse from the normal, involving a destruction of international amenities. When war is over, we return to sanity and to the proper performance of all of our obligations. The old practice of sequestration or confiscation of dividends and interest from National funds of States at war *inter se* has during the last 100 years been abandoned and it is assumed that none of the nations now at war will default in payment of their obligations.

Naturalization.

The war has placed a premium on the legal process whereby a man renounces the nationalism of his nativity to adopt that of the country of his adoption. It is a performance that can be viewed from various points of view and depends upon motives not to be gauged by the bystander, nor indeed to be understood wholly by the performer himself. A person who forswears Portugal while resident in Rumania, for example, is a poor kind of Portuguese and therefore presumably will make a poor kind of Rumanian, yet most Rumanians would consider the transfer of allegiance complimentary to themselves. The Portuguese of our supposition is no more sympathetic to, comprehending of, or loyal to, the Rumanian's idea of life, literature, and government than he was the day before he became a renegade to the land of Camoens; he has simply rehearsed a formula that gives

him sundry legal privileges in the country of his adoption. Naturalization is not an intellectual, but a legal, process. Like other legal processes it may be purely formal. We know only two tests of identification or assimilation with an alien country: (1) the ability to speak that country's language and (2) the willingness to serve it. Of the language test it may be said that no man can be in comprehending sympathy with a country until he understands its language and reads its current literature; the speaking of the language is an advanced step to that position. On the other hand, a good linguist may be a traitor in mind, while a poor linguist with a harsh accent may still be a devoted national in the country of his residence. In default of a better test, that of language is useful; in any case, it is more indicative than naturalization. The second is the supreme test; if a man will give time, money, or labour, above all, if he will risk his life, or his son's life, for a country, he is a true national and deserves more to be so regarded than the recreant native. A few days ago the London agent for Krupp's was under suspicion; the Krupp machinery company is now an alien enemy, more particularly as a manufacturer of armament, but its representative in this country lost a son while fighting under the British flag in South Africa. His name may be spelled in a Germanic way, but he is as much entitled to call himself an Englishman as Ponsonby de Tomkyns. It is not generally known that the ordinary naturalization of Germans and Austrians does not involve a complete break with the country of their nativity; the change of nationality is not completed until they obtain a formal release of allegiance from Germany or Austria. This is rarely accorded. On an English passport issued to an alien so naturalized it is stated that the passport is granted "with the qualification, that he shall not, when within the limits of the foreign State of which he was a subject previously to his obtaining his

certificate of naturalization, be deemed to be a British subject of that State in pursuance thereof or in pursuance of a treaty to that effect." Unless formally released by the German or Austrian governments, all Germans and Austrians of military age must return to their native land in time of war, on penalty of being treated as deserters. Such enemy aliens may have been classed here as naturalized Englishmen a week before the declaration of war. Naturalization in such cases is no more than equivalent to the declaration of intention to become an American citizen. The United States, on the other hand, releases, without demur, any of its nationals that may choose to be naturalized in another country; but the American people look on such action with intense contempt. The point is that a German or Austrian naturalized in England obtains sundry legal advantages, and the privilege, as we naturally deem it, to call himself an Englishman, but he still remains, in most cases, a German or Austrian, as the case may be, in the eyes of the Kaiser's or the Emperor's government. Some there are that make themselves international chameleons, changing their colour with their environment. Others there are, and many of them, that, while German in name and in speech, have strong aversion from Prussian militarism; indeed, if they came from southern Germany or the former Free Towns, their own fathers may have fought against Prussia in 1866. The point we desire to make is against ill regulated prejudice one way or the other. All naturalized Germans are not loyal Englishmen and all Germans are not supporters of the Potsdam War-Lord. We must take each individual as we find him, and as we have good reason to suppose him to be, expecting loyalty to King George from naturalized aliens and loyalty to the Kaiser or the Emperor from native Germans or Austrians, but in every case avoiding the making of any unnecessary addition to the cruelties inseparable from war.



SPECIAL CORRESPONDENCE

VANCOUVER.

The Annual Report of the Minister of Mines for British Columbia for the calendar year 1913 was issued about the middle of July. It is a larger volume than those of past years, containing 450 pages. The figures showing mineral production for the year, with those for 1912 for purposes of comparison, are as under :

| Mineral. | 1912. Quantity. | Value. | 1913. Quantity. | Value. |
|---|--------------------|--------------|--------------------|--------------|
| Gold, placer.....oz. | — | \$ 555,500 | — | \$ 510,000 |
| Gold, lode.....oz. | 257,496 | 5,322,442 | 272,254 | 5,627,490 |
| Total gold | — | \$ 5,877,942 | — | \$ 6,137,490 |
| Silver | 3,132,108 | 1,810,045 | 3,465,856 | 1,968,606 |
| Lead.....lb. | 44,871,454 | 1,805,627 | 55,364,677 | 2,175,832 |
| Copper | 51,456,537 | 8,408,513 | 46,460,305 | 7,094,489 |
| Zinc | 5,358,280 | 316,139 | 6,758,768 | 324,421 |
| Total value, metalliferous | | \$18,218,266 | | \$17,700,838 |
| Coal.....long tons | 2,628,804 | 9,200,814 | 2,137,483 | 7,481,190 |
| Coke..... " | 264,333 | 1,585,998 | 286,045 | 1,716,270 |
| Miscellaneous products (building materials, etc.) | — | 3,435,722 | — | 3,398,100 |
| Total value of mineral production..... | — | \$32,440,800 | — | \$30,296,398 |

While there was a net decrease of \$2,144,402 in total value of the minerals produced, partly accounted for by lower average prices for the year of several of the metals, it will be seen that there was a larger production, in quantity, of some of the minerals. Leaving 1912 out of account, in no other year has the recorded value of total production been so high as in 1913, the nearest having been \$26,377,066 in 1910. The production of lode gold was the greatest in all years. The smaller quantity of copper produced was due chiefly to the lower copper content of much of the ore smelted. The decrease in output of coal was attributable to labour troubles at Vancouver Island collieries. The quantity of coke made was the largest on record in the Province. The gross value of the mineral production for all years to the end of 1913 was \$460,433,920. The production by districts last year was as follows: Cariboo, \$226,024; Cassiar, \$412,748; East Kootenay, \$5,947,935; West Kootenay, \$7,092,107; Boundary (including Similkameen and Nicola valley), \$7,925,336;

Lillooet, \$71,445; Coast, \$8,620,803. Of the districts making the larger production, East Kootenay's total includes \$4,861,000 for coal and coke, the greater part of the remaining \$1,087,000 being for lead. West Kootenay's total is practically all for metalliferous minerals, in largest part for gold from Rossland mines, and next for silver and lead from Slocan and Ainsworth mines, together with more than \$500,000 in gold from mines in Nelson division. The approximate proportions from Boundary district were: Gold, \$2,092,000; silver, \$224,000; copper, \$4,370,000; structural materials, \$295,000, and the remainder chiefly coal from Nicola valley. In the Coast district the proportions were: Gold, \$95,000; silver, \$58,000; copper, \$2,206,000; coal, \$3,407,000, and structural materials, \$2,854,000. The production of Cariboo, Cassiar, and Lillooet districts is in large measure gold—lode gold from Lillooet and placer gold from the other districts.

The number of mines that shipped ore was 110, as against 86 in 1912, and 28 non-shipping mines were worked. The total output of ore was 2,663,809 tons. The number of men employed in these mines was 4278—2773 below and 1505 above ground. The corresponding figures for 1912 were: worked below ground 2473, above 1364, total 3837. At the coal mines, there were 6671 hands employed (including 124 boys)—5828 whites, 837 Chinese and Japanese, and 6 B.C. Indians. Those employed underground numbered 4950 (including 409 Orientals) and above ground 1721. The gross production of coal, including that made into coke, was 2,570,760 tons. Figures for 1912 were: employed underground 5275 (including 323 Orientals), above ground 1855 (416 Orientals), total 7130 (221 boys); gross production of coal, 3,025,709 tons.

Cariboo.—The season promises to prove an average one as regards the quantity of placer gold recovered. The most productive mines are, as in other recent seasons, those of John Hopp, situated in the neighbourhood of Barkerville, in Cariboo division. In Quesnel

division little hydraulicking is being done. In Omineca division, the chief placer gold bearing parts of which are included in Cariboo district, several hydraulic enterprises have been undertaken, but gravel-washing to any considerable extent has not yet been done this year. The completion of the Grand Trunk Pacific transcontinental railway through the northern part of Cariboo district, and the progress with construction of the Pacific Great Eastern railway from the coast near Vancouver, via Lillooet and through the chief gold-producing parts of the district, together give promise of greatly facilitating mining in Cariboo, but the beneficial effect of progress toward this provision of better transportation facilities will not be experienced this year.

Cassiar.—In the Atlin division the outlook is favourable to a further increase in production of placer gold, there being activity on several creeks, and especially on O'Donnell river, a stream on which much prospecting was done in 1913 in preparation for gravel-washing this year, with results generally encouraging. The largest operator on the O'Donnell is a company organized last winter by J. M. Ruffner, of Cincinnati, Ohio, manager of the North Columbia Gold Mining Co., which during recent years has made the highest production of gold from Atlin creeks. Several other companies are also engaged in hydraulic gold-mining and are washing much gravel. It does not yet appear that much important provision has been made for recovery of lode gold from Atlin mineral claims, notwithstanding occasional reports of intention to erect large stamp-mills. Small veins, in places very rich in gold, are known to occur, but systematic development of lode-gold properties under competent direction is not the rule in this division.

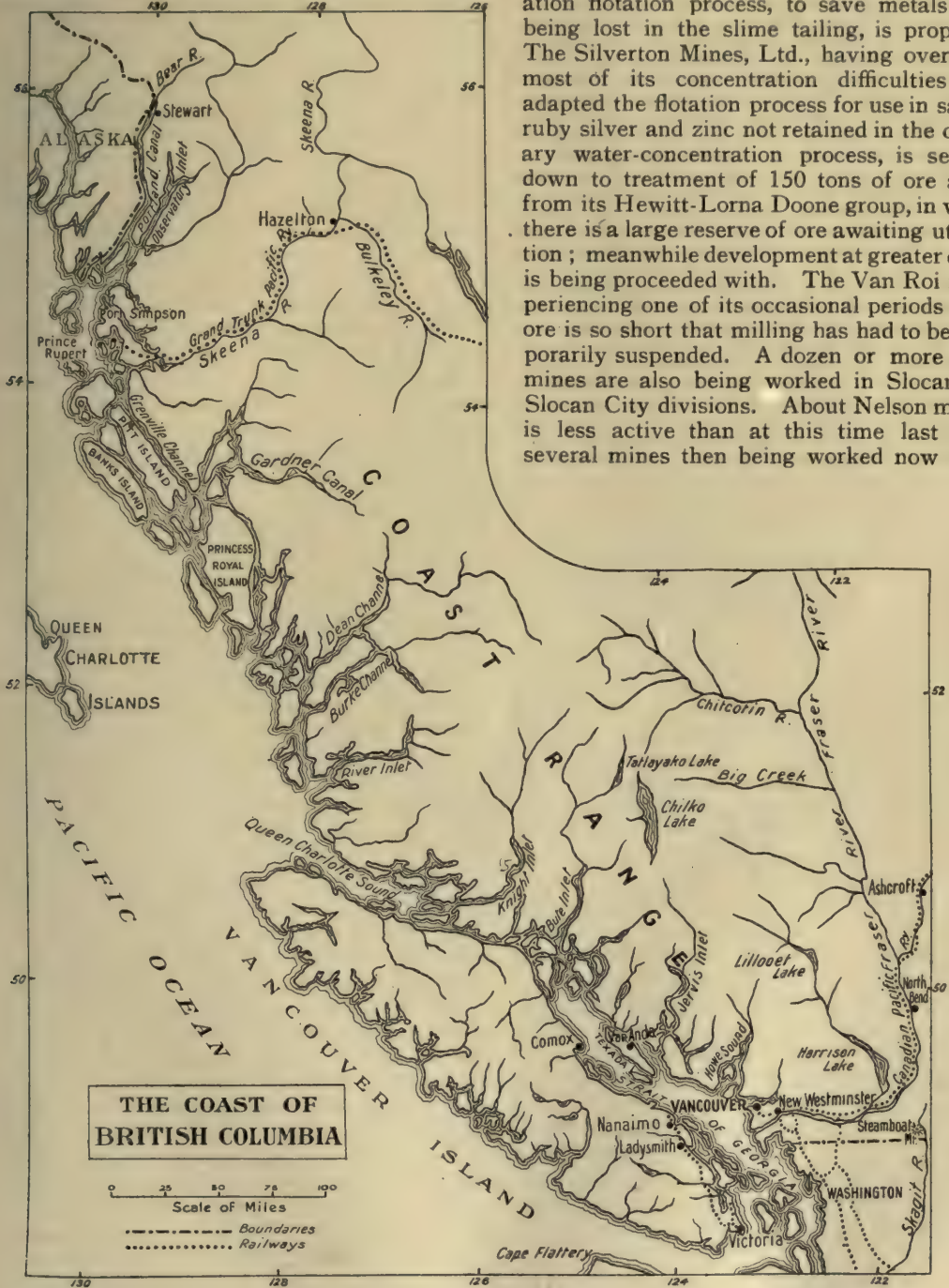
East Kootenay.—The demand for coal has not been continuous to an extent that would have admitted of the larger coal mines being kept productive without interruption. The Crow's Nest Pass Coal Co., which last year produced on an average 87,000 long tons of coal per month, and of that quantity made 28,000 tons into 19,000 tons of coke, disposing of the remainder as coal, continues to operate coal mines at Coal creek and Michel and coke ovens at Fernie and Michel. The Hosmer coal mines have been closed and dismantled of plant and machinery, the coal measures having proved too much disturbed and the coal too broken for mining to be carried on with profit; the coke ovens, however, will still be used, burning slack from other mines.

The Corbin No. 1 mine having been sealed off last year to isolate a fire, No. 4 mine has since been producing about 300 tons of coal a day, while No. 3, worked on the open-cut or quarry system during half the year when there is no snow, supplies 150 tons a day. Drilling for oil in the Flathead country, Southeast Kootenay, is giving results that are inducing the boring of larger wells. New discoveries of placer gold in Fort Steele division were reported in July. Lode mining is confined chiefly to the Sullivan group and St. Eugene lead mines; during seven months to the end of July the former shipped approximately 13,000 tons of lead ore to Trail and the latter 750 tons.

West Kootenay.—The mining divisions of this district that are productive to an important extent are Ainsworth, Slocan, Nelson, and Trail Creek. The Consolidated Mining and Smelting Co. is working the Highland mine and concentrating mill and the No. 1, Banker, and Maestro mines. Ainsworth & Highland and No. 1 are regular shippers of silver-lead ore to Trail. A small hoist, compressor, and electric power and light appliances have been put in at the Silver Hoard. Across Kootenay lake from the town of Ainsworth, the New Canadian Metal Co.'s. Bluebell mine and concentrating plant are being worked continuously, with Mr. S. S. Fowler as general manager. A marble quarry, north of Kootenay lake, and the Cork, Utica, and J. L. Retallack & Co. silver-lead mines in the western part of the division, are being operated. In the Slocan division, the Rambler-Cariboo silver-lead-zinc mine has enough ore in sight to keep its concentrator supplied for two years. Deep development of the Payne, in past years the best dividend payer of this district, has not yet resulted in much ore being found. The Slocan Star mine is now in a position to keep its concentrator uninterruptedly supplied with ore, so milling has been resumed after the mill had been idle seven or eight years; a silver-lead product is being shipped to Trail and a silver-zinc concentrate to Bartlesville, Oklahoma, U.S.A. The Ruth-Hope and the Wonderful, both near Sandon, now have ore opened and will be shippers again. Some ore is still being mined at the Richmond-Eureka. The Surprise is being equipped with concentrating plant after a long and eventually successful search for ore at depth; a deep-level crosscut adit is being driven on the Noble Five group, with several known veins ahead; another shoot of ore has been found on the Reco,

which in past years has been a paying mine; several other mines near Cody are also being developed. In Silverton camp, near Slocan

per month as a dividend to its shareholders, and semi-annually an extra dividend of like total amount. The use of the Minerals Separation flotation process, to save metals now being lost in the slime tailing, is proposed. The Silverton Mines, Ltd., having overcome most of its concentration difficulties and adapted the flotation process for use in saving ruby silver and zinc not retained in the ordinary water-concentration process, is settling down to treatment of 150 tons of ore a day from its Hewitt-Lorna Doone group, in which there is a large reserve of ore awaiting utilization; meanwhile development at greater depth is being proceeded with. The Van Roi is experiencing one of its occasional periods when ore is so short that milling has had to be temporarily suspended. A dozen or more small mines are also being worked in Slocan and Slocan City divisions. About Nelson mining is less active than at this time last year, several mines then being worked now being



lake, the Standard is continuing to do well, keeping its concentrating plant fully employed with results that admit of payment of \$50,000

inoperative. Exceptions are the Molly Gibson and the Silver King, both operated by the Consolidated Mining and Smelting Co. Dur-

ing seven months, to August 1, more than 12,000 tons of ore has been sent to Trail from the Silver King. At both Ymir and Sheep creek, in the southern part of Nelson division, the mining outlook has improved; ore has been developed in the Dundee, Yankee Girl, and Wilcox mines, Ymir, and plans for mining and treating it are being considered by the respective owners. Ore from a shoot 25 ft. wide is being extracted at the 600-ft. level of the Queen gold mine, Sheep creek; in the same neighbourhood the Motherlode gold mine and stamp-mill are being worked full time. The Emerald and H.B., two lead mines within ten miles of Salmo, are sending ore to that station for shipment thence to Trail. At Erie, the Second Relief is being worked.

In the Trail Creek division, the only present productive mines are those at Rossland, namely, the Consolidated Co's. Le Roi and Centre Star-War Eagle groups, and the Le Roi No. 2 Co's. Josie group. Approximate output of ore for the expired seven months of the year has been as follows: Centre Star-War Eagle group 92,000 tons, Le Roi 40,000 tons, Le Roi No. 2 Co's. Josie group 12,000 tons. These figures show the ore receipts at the Trail smelter from the several mines. The quantity of ore taken from the Josie group was larger than shown above, but the lower grade ore was concentrated at the mine and the product included in the total of ore shipped. All these mines look well for continued production. Much ore has been found on the 14th level of the War Eagle and work in progress on the 16th level indicates that the ore lives down that much farther at least. A fine shoot of ore is being explored in the Le Roi No. 2 Co's. Annie claim from a working that is an extension of the Le Roi 1650-ft. level; this shoot appears to come in from the Le Roi Black Bear claim, so most likely will also be productive in that property. The Consolidated Mining & Smelting Co. continues to make important improvements at its lead and copper smelting works and electrolytic lead refinery at Trail. Another of the old copper blast-furnaces has been replaced by a new furnace, 42 in. by 35 ft. at tuyere level, and having 28 standard tuyeres on each side. This furnace, like one put in last year, has been built with an arched top and flat flue instead of having the old-style goose-neck over the furnace, the object of doing away with the goose-necks being to leave a clear space for an overhead travelling electric crane already at the works and to be put in as soon as shall be practicable. Two new lead blast-

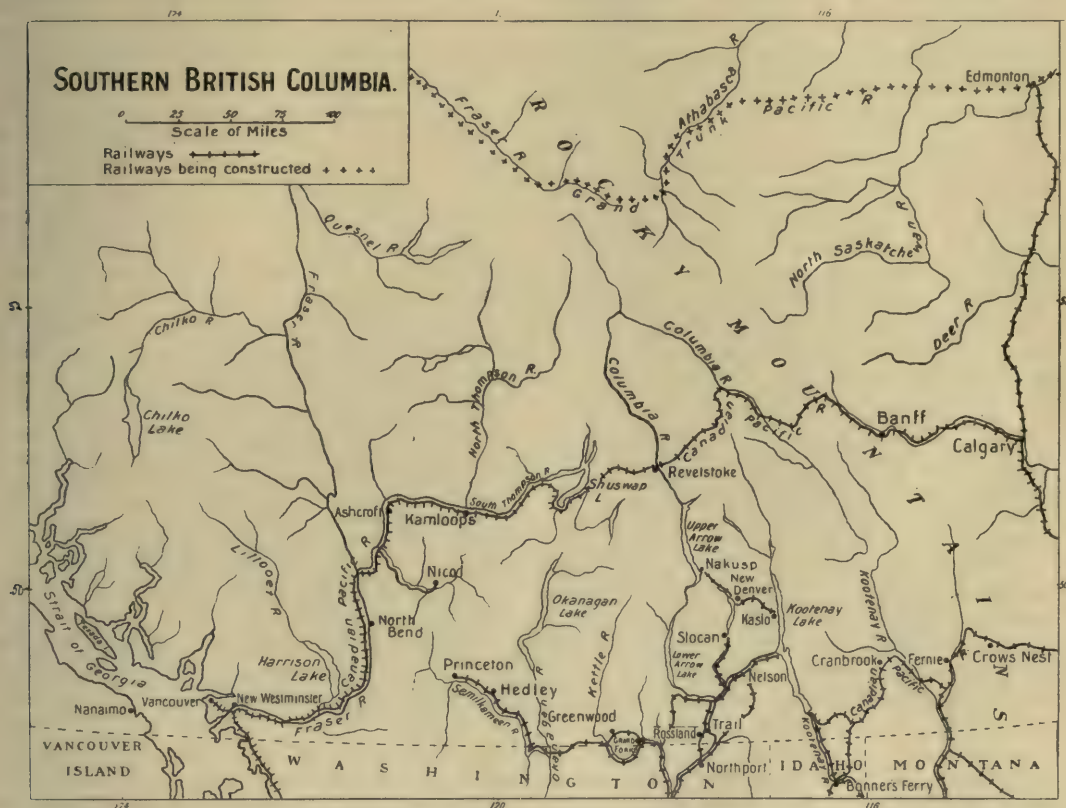
furnaces, 45 by 216 in. at the tuyeres, are running and another is being constructed. A new smoke stack, of reinforced concrete, to be 250 ft. in height, is approaching completion. Two Wedge roasters have been installed, and other betterments made in the ore-roasting department. The Cottrell system of fume condensation is being given a trial. More solution tanks have been added in the lead refinery. There is little to note in other divisions of West Kootenay. Reports of gold dredging on Lardo river have been printed, but operations are experimental and on a small scale. Silver-lead ore in a small quantity still goes out from Ferguson mines. Tin ore has been found in northern Lardeau, but is not yet developed. Placer mining for gold has been resumed in the Big Bend country.

Boundary.—There is little new in connection with the copper mines of the Granby Consolidated and British Columbia Copper companies, which are steadily maintaining a comparatively large production of low-grade copper ore. Charles A. Banks has succeeded in finding ore of better quality on the 400-ft. level of the Jewel gold mine than that worked nearer the surface; development at the 500-ft. level has since been undertaken; a Dorr classifier has been added to the mill equipment. The Hedley Gold Mining Co., with Gomer P. Jones still in charge, is mining and milling its usual quantity of gold ore—approximately 6000 tons a month. Construction work in connection with the hydro-electric power system for which the directors some time ago made an appropriation of \$200,000, is now well advanced. The New York Syndicate No. 2 has resumed diamond-drilling on the group of mineral claims adjoining the Hedley Co's. Nickel Plate group. The British Columbia Copper Co. (or probably the Canada Copper Co., organized to acquire the B. C. Copper Co's. property) has been doing more diamond-drilling and prospect development on a large group of claims on Copper mountain, distant 12 to 15 miles from Princeton, which, as well as Hedley, is in the Similkameen country; it is claimed that the work done warrants an estimate of the occurrence of fully 5,000,000 tons of ore on the property being explored. Neither the cement manufacturing works nor the coal mine near Princeton is making much of a production just now. Placer gold mining is being done on Tulameen river, between Princeton and the mouth of Granite creek; also on the last-mentioned stream. Further development of the Coal-mont coal lands has been in progress all this

year. High freight-rates have prevented advancement of the interests of coal mine operators in Nicola valley, who hope for relief when a competing railway, now being constructed, shall be open for traffic. Near Kamloops, the Iron Mask group is producing some copper ore which is being shipped to Trail.

Lillooet.—Railway and wagon-road construction in this district is removing what

Magazine for May. Both rises from the 4350-ft. long crosscut adit then mentioned are now up nearly two-thirds of the 1200-ft. distance between the adit and the lowest level of the older workings above. The grading of the railway from the portal of the adit to the top of the 5000-ft. incline down to the concentrating mill is finished and much of the steel laid. Nearly all the heavy rockwork in grad-



has heretofore been the chief obstacle to mining development, namely, lack of transportation facilities. As yet the effect is not noticeable to any considerable extent, for much remains to be done to meet the needs in this direction of different parts of the district. Recovery of placer gold has been gradually diminishing until last year's yield of \$3000 was less than one-tenth of that of ten years ago—1904; on the other hand, more lode gold was won last year than during the whole of the ten-year period, 1903-1913.

Coast.—The Britannia Mining & Smelting Co. is steadily advancing its important surface construction and underground development work toward completion. Some particulars of this work were printed in *The Mining*

ing the incline has been completed; the cost of making this incline is stated to have been approximately \$120,000. Owing to procrastination in the Government Water Commissioner's department in deciding upon the company's claim for water rights, it has been determined to put in a steam power plant of 3000 h.p. capacity for generating electricity and other purposes, and in this connection turbine engines have been ordered through Fraser & Chalmers and steam boilers from Canadian manufacturers. Meanwhile the existing hydro-electric generating 1800-h.p. plant with auxiliary steam of 650 h.p. is taxed to its full capacity. The present mining and milling maximum capacity is nearly 700 tons a day—approximately 250,000 tons a year. Con-

struction of a new concentrating mill is in progress, with excavation and grading of the site well forward and timbers framed for building. In addition to about 700 men employed in mining, milling, and construction work, the company has nearly 100 men engaged in prospecting and developing mineral claims in the mountains surrounding the Britannia mine, these claims being held under option of purchase. Two groups in particular give promise of proving worth acquiring and working, having comparatively large showings of copper-gold ore of fairly good grade. Britannia Co.'s ore production last year was 215,589 tons of which 215,121 tons was milled. Crude ore and concentrate shipped totalled about 45,000 tons; approximate gross contents were gold 89 oz., silver 72,300 oz., copper 13,167,000 lb. This year's output, if no interruption to production shall occur, will be larger. The only other mine in the lower Coast district worthy of mention as a producer in quite recent years is the Tacoma Steel Co.'s Marble Bay mine, near Van Anda, Texada island. Here, according to an official report just published, the mineralization, consisting of chalcopryrite and bornite containing some gold and silver, occurs in a gangue of feldspar, garnetite, and some tremolite. Native silver is also found in the mine, though not in considerable quantity. The main shaft has been sunk to a depth of 1000 ft. and from that level, 180 ft. from the shaft, a winze has been sunk 300 ft., making the depth 1300 ft. vertically below the surface, or 1250 ft. below sea-level (the mine is close to the sea). Present work is on the 1200 and 1300-ft. levels, and one fair-sized pocket of ore has been found between those levels. This ore is now being stoped; it consists of chalcopryrite and bornite in a gangue of lime, feldspar, and garnetite. Much bornite is present, and its occurrence down to more than 1200 ft. below sea-level is quite unusual. Other metalliferous properties in the lower Coast district are the Cornell and Little Billie, on Texada island; the Valdes Island Co.'s good-looking copper prospects on Quadra island of the Valdes group; the Quatsino Copper Co.'s group, the Ptarmigan Mines Co.'s claims, and the Kallapa near Clayoquot, all on Vancouver island. The last-mentioned has shipped a few hundred tons, but the others have neither shipped ore nor had sufficient development done on them to determine their prospective value as producing mines.

The coal-miners' strike on Vancouver island has failed. Only one company, and that

the smallest, yielded to the demands of the U.M.W. of A. The other companies are operating their respective mines, with more men offering than they can find employment for. The Vancouver Island coal trade has been adversely affected, to a serious extent, by the labour troubles of 1913-14, so that the market for coal is much smaller now. The position of many of the strikers is now a bad one, for the United Mine Workers has ceased to pay strike money and there is no employment obtainable by them at Island coal mines.

Space limitations prevent more than passing mention of other coast mining. A Philadelphia-Nevada company is working the Surf Inlet Gold Mines Co.'s property on Princess Royal island under option of purchase. In Skeena district, within a short distance of the Grand Trunk Pacific railway, both silver-lead and copper properties are being developed, in some cases with excellent prospects of success. The Granby Co. has three furnaces in operation at Anyox, Observatory inlet, and an abundance of copper ore blocked out at its nearby Hidden Creek mines. Particulars of this noteworthy enterprise will follow later. In Portland Canal division, recent results of work at considerable depth are encouraging.

NEW YORK.

The war in Europe has so disturbed the current of affairs in America that there is little interest in any other topic just now, and the passing of the Huerta regime in Mexico, followed by the entrance of Carranza into Mexico City, has gone almost unnoticed. As a matter of fact, the Mexican situation is still a very interesting one. Carranza has rather clearly exhibited himself as a sort of modern Don Quixote, with less lofty moral ideals than the original, and it is certain that he will never prove a vigorous and successful executive. Villa, who has furnished all the common sense and ability of the campaign that has now been brought to a successful close, is likely to tire of the rôle of Sancho Panza, and the kaleidoscope of Mexican politics may begin to whirl again. It is unfortunate that Villa is an unlettered man, for if he felt himself capable of successfully administering the government he would supply the vigorous personality now so needed in Mexico.

Copper.—Although New York is 3000 miles from the seat of war in Europe, the effects were none the less quickly transmitted here. Some of them were obvious, the others somewhat unexpected. The copper mining

and refining industry has been the most affected, since over one-half of our copper output is regularly shipped to Europe. The mines promptly met the situation by announcing that they had decreased their output to one-half of normal. But even this cannot restore a normal market, since the copper that the mines have been producing in the past three months is still in its course of routine through the refineries, with no prospect of finding a

that silver is practically unsaleable here, though China and India would undoubtedly be eager purchasers were it possible to get it to them. The course of markets is almost incomprehensible, for wheat can less easily be shipped abroad than can silver, and yet the price of wheat has gone soaring in the United States. The difference is probably due to the large consumption of silver in manufacturing in the countries now at war, a consumption



THE WASTE OF WAR—IN MEXICO.

The accompanying photograph gives an idea of the damage done to the railways. It shows a portion of the 14 trains, each consisting of 20 to 25 cars, burned by the Federals on their retreat from Chihuahua to Ojinaga in March last year. Of the 14 engines, all but one were destroyed.

European market. In addition, domestic consumers have cut their purchases to the bone, since no one knows what the course of business here will be in the next six months, and are therefore unwilling to purchase for anything except immediate requirements. Sales of copper are being made, of course, but the dealers have refused to give out quotations, a situation which somewhat embarrasses the smelting companies, which have contracts providing that they shall pay for their ore supplies on the basis of the daily prices of the metals in New York.

Silver is another metal on which quotations have disappeared coincidently with the disappearance of the London market. So fixed are the channels of banking and commerce

that will be absolutely cut off, for the time being at least. Silver may therefore continue to go down in price, to the distress of the Canadian, Mexican, and Nevada mine-owners, and to the great advantage of the Chinese merchants, who will be able to sell their exports for gold prices and take the equivalent in silver, the medium of exchange in which they do all their domestic business.

Zinc and Tin.—Nearly all the other metals have gone up in price, with the exception of lead, which is always so sluggish that it seldom responds to any market movement. Spelter has advanced in price in the expectation that producers here will soon be able to ship to England to replace part of the Belgian supply, now cut-off. Not more than a part of the nor-

mal English demand can possibly be diverted to this country, but even a fraction of it will suffice to advance the price of spelter here. Tin has made a tremendous advance in price. There is no reason why the considerable output of tin from Bolivia should not go directly to the United States, especially now the Panama canal is open, except that American banks have no facilities for carrying on banking operations with South America, and it is easier to send South American products to London and ship them back, just as it is easier to go around a wood than to make a road through it, so long as the amount of travel over the route is small. It is already evident that one of the results of the present conflict will be to establish direct relations between this country and others as regards many commodities. Bolivian business men, for example, have already opened negotiations with firms here for the smelting and refining of Bolivian tin ore in this country. The Chinese tin, which now enters the world's commerce at Hong Kong, might also be sent direct to the United States through the Panama Canal, as that route is shorter than the one it now follows. Antimony is another metal that has gone up tremendously in price because the British commission house is interrupted in its operations. The most important source of supply is now Hunan province in China and the metal there is as near to New York as it is to London, whence it goes for re-shipment. Antimony is one of the sentimental metals; in other words, its price is governed by other factors than supply and demand. Cookson's antimony always commands a price of $1\frac{1}{2}$ c. per pound more than the Chinese brands; a difference very much greater than the cost of refining the Chinese antimony to the grade of Cookson's.

Another result of the war will be that several products will be made in the United States that are now being imported. One of these is ferro-manganese. This has been nearly all imported, as the iron men here seem to prefer to confine their operations to the making of pig-iron and steel, and to buy ferro-manganese and spiegel. There are good supplies of manganese ore available in Cuba and California, but the Caucasus and Indian ores are of such high grade and can be laid down in Europe so cheaply that there is no incentive to develop the domestic supply. Now that imports are cut-off some of the iron men will have to devote some of their idle furnaces to the making of ferro-manganese and the domestic ores will have a chance for a time at least. The New Jersey Zinc Co. has always

produced quite a little spiegel as a by-product of zinc production from its franklinite ores. The zinc producers will have to take-up also the making of zinc-dust in order to come to the rescue of the cyanide men, who have been depending on imported zinc-dust. This can be made here easily, but there is little profit in it, and to produce it requires the service of more men, which all the smelters endeavour to avoid so far as possible. The cyanide men have also been relying on foreign sources of supply for their cyanide, and the interruption of that supply is more serious as the amount of cyanide made here is not large and its production is not a matter that can be undertaken on the spur of the moment. The makers of cyanamide have for some time been trying to push their product as a substitute for cyanide, but without much success, as it is apparently not so satisfactory as sodium or potassium cyanide. The supply of cyanamide is ample, and it is cheap, so if the cyanide plants are forced to use it they may eventually find it a usable source of cyanogen.

JOHANNESBURG.

Supplies.—The question of keeping the gold mines running has put forward South Africa's dependence on oversea markets very clearly. Of her requirements for this purpose the most important are explosives, cyanide, zinc, mercury, and drill steel. Of raw material there is sufficient in the country to ensure a nine-months supply of dynamite from its three factories. The annual importation of detonators and fuse amounts to 300,000 boxes and 8,400,000 coils, and of these about four months stocks are carried, while more is on its way out. Under normal conditions large proportions of fuse and detonators are imported from Germany, and a German boat bound for Cape Town with a cargo of this description is reported to have put into Luderitzbucht, fearing British cruisers. The latest cablegrams from Nobels have set at rest any anxiety regarding shortage under these headings. With cyanide the stock carried is sufficient for some two months supply while about the same amount is on its way out. Here Germany supplies 75% of the annual consumption of 11,000,000 lb., but England can be counted on to make up any deficiency provided the trade-routes are kept open.

Labour.—The closing-down of the diamond mines, owing to the collapse in price caused by the European war, will throw out of employment 30,000 native labourers, who would

have been a welcome addition to the Rand supply, which is still 20,000 short of what it was a year ago. "You may lead a horse to a trough but not always succeed in making him drink." You may have a bad farming season and close-down diamond mines, but the natives will not go to gold mines unless they choose. The conditions of working, payment, etc., are essentially different. In the diamond mines all natives are housed in large closed 'compounds' to prevent theft of stones; they feed themselves, and are mostly paid by contract. In the gold mines the compounds are similar but are open, the rationing is done by the company, and the great bulk of natives work on a fixed-pay basis, with, in some cases, a bonus scheme.

Mint.—Until the trade-routes can be rendered secure beyond doubt the export of raw gold has ceased. The Pretoria mint is being overhauled and minting will be revived in South Africa, should the necessity arise, after a dormant period of a dozen years. George V. dies are being made locally.

Coal and Base Metals.—So long as the gold mines are able to continue at work the collieries are likely to be well employed, but once the gold mines cease work the demand for coal must decline materially, although at the present time there is considerable activity noticeable in hurrying coal to the ports in the expectation of large quantities being required for bunkering. What will happen to the tin and copper mines cannot be foreseen, but the local production is not heavy and the lean profits at present made at the tin mines will soon disappear if costs go up, and anything may happen.

The Colour Bar.—It was quite expected that the proposal contained in Mr. E. J. Way's presidential address to the members of the Institute of Engineers to give equality of opportunity to white and coloured employees on the mines would cause considerable discussion. The practice on the Rand has always been for all supervision and skilled work to be in the hands of the whites, and Mr. Way would not only place the coloured on the same plane as the whites as regards payment by result, but would also permit coloured supervision and once and for all place white and coloured employees on the same footing. The effect of such a change on the Rand would be that a large number of the white overseers and skilled workmen would be displaced by the half-caste or Cape boy, but the rough and unskilled work would still be performed by the kaffir. The kaffir has not sufficient intelli-

gence or training at present to do skilled work or act as overseer, but the Cape boy as a skilled workman or overseer would do quite as well as the half-breed Spanish-Indian in other mining regions. Mr. Way mentioned the fact that in bygone days on the Rand the white man supervised much larger gangs of native labour than today, for which the Mining Regulations were to some extent responsible. He gave details of a proposed method of supervising mining operations underground on somewhat the same lines as those adopted in English coal mines, whereby the mine would be divided into districts and placed under more skilled supervision than today. It was shown that many of the white miners were careless, Mr. Way stating that 11% of the accidents due to the fall of hanging wall and 44% of the accidents due to the use of explosives were caused by the neglect of the white miner, more than one-half of the total accidents coming under these two headings. By adopting the district method of supervision under one skilled white overseer and making the best use of coloured labour, Mr. Way suggested that the cost of white labour would be reduced by one-half without adding to accident results, while working costs would be reduced 3s. per ton. This would mean that the total cost of working on the Rand would be brought down to the neighbourhood of 14s. per ton, a figure that would allow the closed-down mines to be re-opened and bring under profitable exploitation the present large untouched areas on the Witwatersrand.

Gold Output.—The Chamber of Mines has issued a statement which shows that the total gold output for the Transvaal for the six months ended June 30 was 4,086,874 fine oz. worth £17,359,824 as compared with 4,640,421 oz. worth £19,711,256 for the corresponding period of 1913, a decrease of 553,574 oz. worth £2,351,432. The fall is due to the strikes and consequent lack of labour. With the uncertainty due to the war there is little probability of the Rand gold output being restored to its normal condition. The tonnage milled during the first half of this year is given as 12,637,971 as compared with 13,883,192 tons in the corresponding half of 1913, while the average number of stamps employed fell from 9,999 to 9,694. Owing to the use of heavier stamps and the more liberal use of the tube-mill the duty per stamp was increased from 8'77 tons to 8'78 tons. The number of tube-mills increased from 286 to 291. The dividends increased from £4,164,143 to £4,215,729.

PERSONAL.

CECIL BAKER and HUGH BAKER, two sons of F. W. Baker, have received commissions, one in the Duke of Cornwall's Light Infantry, and the other in the Royal Horse Artillery.

H. T. BRETT has been appointed manager of the Falcon mine, in Rhodesia.

R. GILMAN BROWN has returned from Russia, after a journey of eight days from Petrograd to London, by way of Finland, Sweden, Norway, and Scotland.

E. J. CARLYLE left for Sissert, in the Ural region, on August 29, by way of Finland.

W. J. CHALMERS has booked a passage in the *Olympic*, sailing on September 16.

H. N. G. COBBE is back from British Guiana.

PHILIP CORDNER-JAMES and DEREK TRE-WARTHA-JAMES, the sons of James Bros., have received commissions in the army.

C. R. CORNING has returned to New York from Chile.

J. H. CURLE has returned from a tour through Central America.

D. G. DEGENHARDT, lately with Bewick, Moreing & Co., has left Kalgoorlie for London.

FRANCIS J. DENNIS has returned to New York.

ANTON EILERS, KARL EILERS, and family sailed for New York on September 7.

J. C. FARRANT, London representative of the Hardinge Conical Mill Co., is with the Naval Volunteers.

D. L. H. FORBES has been appointed chief constructional engineer to the Chile Exploration Co., and has gone to Chuquicamata.

DONALD F. FOSTER has gone to Venezuela.

J. S. HENRY has gone from Australia to the Malay States to superintend the erection of a dredge for the Kampong Kamunting Tin Company.

ALFRED FOX, C. M. CARROLL, and GEORGE SIMPSON have joined the Public School Corps.

JAMES HOWLISON has returned from Abyssinia, after an absence of 10 months.

R. LOCKHART JACK, Assistant Government Geologist, is head of an exploring party in the mountain ranges of central South Australia.

W. B. JACOWAY has been appointed manager of the Broken Hill Proprietary's iron and steel works at Newcastle, New South Wales.

THOMAS JOHN JEHU has been appointed professor of geology in the university of Edinburgh in succession to James Geikie.

A. T. KING has been appointed manager of the Basset & Grylls mine, in Cornwall.

C. B. KINGSTON is in Rhodesia.

E. S. KING and A. T. KING have resigned as consulting engineer and manager, respectively, to the Carn Brea & Tincroft Mines.

C. E. KNECHT, manager of the Brakpan, is here from Johannesburg.

N. BOOTH KNOX has returned from Russia.

H. H. KNOX is on his way, through Scandinavia and Russia, to the Altai.

GEORGE E. MACMULLEN has arrived from Naraguta, Nigeria.

E. SEABORN MARKS has a commission in the 23rd London regiment.

HAROLD MARTIN has joined the Honourable Artillery Company.

GEORGE CHESTER MASTER is home from Nigeria, invalided by fever.

J. R. PEBERDY, of the Junction North, Broken Hill, has gone to the Bawdwin mines, in Burma.

E. DAVID POPE has opened an office at Casilla 2705, Santiago, Chile.

A. L. QUENEAU, formerly at Broken Hill, is in the French cavalry, while his wife and four children are at Jemappe-sur-Meuse in the vicinity of Liège.

J. B. RICHARDSON has returned from Colombia.

H. M. RIDGE escaped from Dusseldorf after three weeks detention.

HEINRICH RIES, professor of economic geology in Cornell University, sailed from Liverpool on September 4.

J. R. H. ROBERTSON has returned to the Mysore mine, India.

J. H. RONALDSON has returned from Sumatra.

P. A. SEIBERT sailed on the *Rochambeau*, on August 29, going from France to Maryland.

GEORGE SCHACK-SOMMER, recently in the cyanide department at Tanalyk, is in the Russian army.

H. R. SLEEMAN has returned from West Australia.

G. H. STANLEY has been elected president of the South African Association for the Advancement of Science.

RALPH STOKES, on the declaration of war, hastened from New York to England, and is now a sapper with the Royal Engineers.

STEPHEN TAYLOR, until recently an office-boy in the service of this Magazine, is now a man in the Army.

WILLIAM THOMAS is now manager of the Carn Brea & Tincroft mines, near Redruth.

H. L. TWITE is due from Burma.

IRVING WRIGHT and family will sail by the *Celtic* on September 30.



DISCUSSION

England's Metallurgical Opportunity.

The Editor:

Sir—The re-arrangement of trade to be expected and the opportunities that will be offered to British manufacturers when the war is over, and even now, are the subject of general discussion and it would be of great assistance to the metallurgical and mining professions if you would publish statistical and general information on the subject.

The position of the metallurgical industry in England is curious and paradoxical. The iron and tin industries are sound and flourishing, although many branches of the former are influenced by the failure of Continental supplies. Others are at a low ebb and require that impetus which can only be given by proved requirements and that influx of capital which can only be obtained under the strongest promise of adequate return. All the necessary factors now exist. Mining is likely to be but little interrupted by the war if the products can be treated, but many metallurgical processes on which the mine-owner depends for the disposal of his products, that is, for the ability to continue mining, have been conducted in Germany, Austria, and Belgium, where their operation has now ceased.

It is well known that we are not equipped in England for the treatment of many low-grade or refractory ores and many so-called rare minerals or for dealing with many of the by-products and much of the mineral and metal waste that is readily handled by Continental firms, or that we are not prepared to pay a price that will induce the sellers to send them to us. Economic reasons have something to do with this, but the mental lassitude of our metallurgists and works-managers and the natural desire of our financiers to see a fair return on their capital, such as they have hitherto more readily obtained elsewhere, are mainly responsible. If we fully realize our opportunity and if we can persuade those who control finance that the opportunity exists, we may see greater prosperity in Wales and the development of new metallurgical centres in the British Isles.

Those who have followed the growth of Continental trade, and especially of that dealing with metallurgy and chemistry, must have realized that most of its advance has been due to the fact that what are now the largest and most powerful firms have dealt, not with one branch only of a business, but with the whole tree. The tree may have been grown from British seed and its early development may have been assisted by Britons, but its present condition is due to the fact that while England—from whose inventions and early work so many of the present vast Continental industries originated—has gradually retrograded from an apparently impregnable position, the Continental metallurgical and chemical trade-centres have thriven. They have succeeded mainly because they have had an uphill fight. While we thought only of the plums, they have devoted themselves to the waste. They have converted this waste into revenue, have secured many of the plums and have obtained a hold on metallurgical and allied industries that they would never have lost but for the present crisis.

The statement on the cover of last month's *Mining Magazine* that only 2% of the precious metal production of the world comes from the region directly affected by the war and that only 9% of the base-metal production is mined within the area of probable conflict is highly encouraging, but we must remember that it is useless to mine unless the ore can be dealt with, that a large proportion of the output is treated away from the mines, and that production must cease unless it can be readily marketed.

Taking the refractory zinc-lead ores of Broken Hill as typical of the class of ore from which most of the world's future supplies of lead and zinc and much of its silver will be derived, it is pathetic to note that so much of the work done by Englishmen in devising means of dressing and smelting such ores should have merely resulted in our becoming clients to the Continental firms whose shutting-down has caused the cessation of mining operations in a considerable proportion out of the 91% of

the mining area for base-metals "outside the area of probable conflict." It is poor consolation to an English mining man to know that he is outside such an area if he must also realize that he is outside everything, merely because the metallurgists of his own nationality have allowed Continental firms to obtain control.

Having admitted our error, we have next to consider how best to take advantage of our opportunity. The present metallurgical position is simple, but it requires to be faced as a big proposition. It would be useless to start in a small way except in certain departments and there are branches that it will be better to leave entirely to others. We may anticipate an immediate, short boom in the spelter trade and may look for improvements in other orthodox directions, but the future is for those who can deal with refractory ores and immediate products. Their total amounts are increasing year by year, and they account for a large proportion of the world's output of both precious and base metal, either of which may be regarded as a by-product to the other but both of which are usually essential. The key to the metallurgical future lies in the treatment of refractory ores and the recovery of by-products. Let us reverse the fossilized policy of aiming mainly at high-grade products. This policy has been the ruin of mines abroad and of smelters at home; we should accept from the miner or ore-dresser less highly refined materials and make use of them just as a Chicago pork-packer utilizes the inferior parts and the offal and does not refuse to purchase four-legged pigs because the demand for hams would lead him to prefer porcine centipedes. We could leave to those who dream of the halcyon days of metallurgy, the 80% galena, the 60% blende, the 70% tin concentrate, the 90% molybdenite, the 60% antimonite, and the other wonderful standards of the club metallurgist. The future is for the metallurgist who asks the miners and ore-dressers to supply what is reasonable and not to ruin their enterprises by attempting to provide products that can only be produced at a heavy loss.

In England we have cheap power and fuel, with efficient transport and labour, and we could erect metallurgical plant in or near the colliery districts where land is cheap and where everything would be favourable both for immediate requirements and for expansion and development. It ought to be now possible to persuade capitalists of the desirability of furnishing funds and of carrying out the work systematically and well, on lines quite different

from the spasmodic manner in which money has been thrown away in the past. They must be shown that this is not a gamble unless they wish to make it so. It has always been easier in the past to obtain money for wild metallurgical schemes than to obtain it for legitimate work outside ordinary routine lines, but there should be no trouble at the present juncture if they can be convinced of the fact that an opportunity has arisen for a new era of metallurgical prosperity in this country.

GEORGE T. HOLLOWAY.

London, August 27.

Technical Terms.

The Editor :

Sir—You recently, in connection with discussions in your paper, invited further letters with reference to the use of technical terms and definitions. I write these lines with regard to the terms that may most suitably be generally used in connection with quantities and values of ore.

In the past many propositions have been made by different engineers as to classification of ore under different headings, when dealing with reserves in a mine. The terms 'developed' ore, ore 'in sight,' 'positive,' 'probable,' 'possible,' ore, &c., have been discussed at different times, and I herewith send a few remarks together with my own suggestions as to suitable terms to be used in classifying ore.

It is obvious that, in view of the varying conditions that exist in different mines and deposits, no classification is likely to apply suitably to all cases, and, further, that in using any classification the engineer needs to accompany his estimates with proper explanations.

In my opinion the following classification suits the great majority of cases: (1) Developed ore; (2) Partly developed ore; (3) Probable ore; (4) Prospective ore.

(1). I consider that the terms 'positive ore' and 'ore in sight' are not to be commended. The term 'positive' *ipso facto* infers that the estimated ore given under this heading is positively known to be there, both as to quantity and quality. Truly the engineer knows, when seeing such figures, that he must allow for the usual unforeseen occurrences. This, however, does not make the term a good one, and it is the question of the most suitable terms that is being discussed. The same applies I think to the term 'ore in sight.' This infers that the ore is actually to be seen and measured as to quantity and value, just as

might be the case with ore 'at grass.' It is obvious that this is not the case.

The term 'developed' is more descriptive and correct. A quantity of ore is actually developed and the estimate is made on the results of the said development. The estimates, of course, will not be exactly accurate, but the term 'developed ore' does not necessarily infer such accuracy, and every one with any knowledge of mining knows this. 'Developed' has not the same wide application as 'positive' and 'in sight.' When speaking of an ore deposit, it has a definite meaning that is well understood. It is preferable to use it rather than words having more general application. I consider therefore that the term 'developed' is more suitable for describing ore that is estimated to be being completely developed and to that extent as being known to be available for immediate excavation, and which for that reason is assumed, with proper reservations, to be proved to exist in definite quantities and values.

With regard to reservations when giving an estimate of 'developed' ore, it is certain that, in particular areas of ore blocked-out by development, some blocks will prove on excavation to yield less, either in quantity or value or both, than the estimate; again, other blocks will yield more than the estimate. In so far, however, as certain patches of ore can be expected to be untouched by the development work and consequently never known or excavated, the probabilities are that the estimate made from results obtained in development work will, on the whole, be bigger as regards quantity than the ore actually excavated. The more irregular the deposit the greater the difference between the quantity estimated and the quantity excavated.

To put the matter differently, the estimate as to quantity of ore based on results from development work may be taken to be practically accurate in the sense that the ore actually surrounded by development work is as likely to be greater as smaller in quantity than the estimate. As, however, some of the ore surrounded by development work remains undiscovered, that is, untouched, the quantity excavated will prove less than the estimate. This does not apply to regular deposits but it does to the majority of metalliferous deposits, while it applies to an increasing degree as the deposits become more irregular.

For practical purposes, when making an estimate of 'developed' ore, the most suitable method would appear to be to make the estimate in the usual way from the results ascer-

tained in the surrounding development and then to deduct a proportion that, in the engineer's opinion, should be allowed in view of the characteristics of the particular ore deposit. This, together with proper explanations, should make the matter as clear as is practicable.

It is unnecessary perhaps to indicate that while excavation may, even in irregular deposits, yield tonnages as great as, or greater than, the estimate, owing to the inclusion of lower-grade or barren wall-rock, this does not affect the point. In such case the tonnage of 'ore' (as meant by the report) is increased by the unintentional inclusion of 'waste.' The net result, of course, is to lower the grade proportionately to the increasing of tonnage. The general fact remains that less metal contents can be expected from the excavating than in the estimate, except in unusually regular deposits.

(2). From ore that comes under the heading of 'partly developed,' the term 'probable' has been largely recommended and utilized. I consider that the term 'partly developed' is more accurate and more descriptive, while I consider that the term 'probable' has a more suitable application in another direction. The term 'partly developed' can be used suitably for all ore coming within the general limits of development work, though this work is not finished, that is, the blocking-out of the ore is not complete.

For the purpose of estimating the quantity and grade of such ore, similar methods can be used as for 'developed' ore. There will be fewer data from which to make the estimate and to that degree the estimate will be more unreliable than in the case of 'developed ore.' In estimating for such ore the engineer should be guided by the facts disclosed in the fully developed part of the deposit as to proportion to be deducted from the preliminary estimate, and generally would deduct the same proportion unless there were special circumstances leading him to do otherwise. In making such an estimate, however, for 'partly developed' ore, it should be understood (and explained in places where explanations appear necessary) that there is a bigger degree of uncertainty than in the case of 'developed' ore. The estimate in either case might be above or below the actuality, but, in whichever direction, the estimate of 'developed' ore would be more reliable than those of 'partly developed' ore. For purposes of estimation, this is the great difference between these two classes of ore: the one is a less certain asset than the other.

It would be difficult to lay down specific rules as to the ore that could suitably be classed as 'partly developed.' It would be for the engineer to decide this in each case. Certainly, the ore would need to have development effected on two sides. There would be little difficulty generally in deciding on this point when dealing with a specific case.

(3). The term 'probable' should, I think, be used for ore of which, though it is not developed or partly developed, the data available can reasonably be taken to give indications as to extent, &c. Thus ore within a certain distance below or beyond development work might be in many cases reasonably taken as 'probable.' The distances that it would be reasonable to adopt for such an estimate must, of course, be decided by the engineer, for each particular case. Geological features (such as changes of country-rock, dikes, faults), all facts reflecting on extent of deposit as shown by prospecting and development work and by the outcrop, regularity of deposit, &c., would affect this issue. Ground that had been sufficiently tested by diamond-drilling could suitably be included in estimates of 'probable' ore, especially in the case of more regular deposits. The blanket deposits of the Rand are good examples of the latter.

(4.) The term 'prospective' should, in my opinion, be applied where 'possible' is commonly used. The term is self-descriptive and is a suitable heading under which the engineer can state the prospects or promise as to continuation of ore beyond the limits considered under the previous headings.

In my opinion the word 'possible' is not a good one. Anything, that is not impossible, is possible. It is 'possible' in most cases that new deposits or new orebodies may exist apart from the deposit or orebodies with which the report deals and of which there are at date of reporting no indications whatever. A report does not pretend to deal with such possibilities. It deals with ore, of which there are certain chances that the existence will be proved when and if the requisite work is performed.

I have said that the above terms are not suggested as suitable for every case. I have myself had to deal with instances where the terms 'developed' and 'partly developed' ore did not seem the most suitable, and where I have described such ore as apparently was proved and reachable by existing development work by the term 'available' ore, accompanying my use of the term by explanations. But

in by far the greater majority of cases my suggested terms have stood the test of experience.

H. R. SLEEMAN.

London, August 10.

Short Tube-Mills.

The Editor :

Sir—Relative to the discussion which is taking place in your columns under the above subject, the instances cited by Mr. J. C. Farant in your June issue, in attempting to prove the superior efficiency of the conical mill, are, to my mind, neither conclusive nor convincing.

In the first instance, where the San Poil Consolidated Co. reduced the diameter of an 8-ft. cylindrical mill to 6 ft., by using a thicker lining, the result, naturally, was what might have been expected: the horse-power was reduced, and so was the capacity of the mill. The same phenomena might have been recorded had the mill been an 8-ft. conical one reduced to 6 ft. A statement of this kind, therefore, cannot be accepted as evidence either for or against the cylindrical mill.

In the second instance cited where the Federal Mining & Smelting Co. converted a 7 ft. by 12 ft. cylindrical mill into a conical mill, by altering the lining, recent experience would tend to prove that a more favourable result would have attended the shortening of the mill, leaving the interior of the shell in its original cylindrical form. A reduction of 2 ft. in the length of the shell would have resulted in a corresponding reduction of, approximately, 15 to 17% in the horse-power, and would have given a more desirable concentrating product, with a greater capacity than could be obtained from the mill in its conical form.

The proper method of determining the relative efficiency of any two machines is to operate them under identical conditions, and under independent observation. The Butte & Superior Copper Co., at Butte, Montana, recently carried out such a test, grinding to 40-mesh, and, from the best information available, a 7 ft. by 10 ft. cylindrical mill was decidedly superior to an 8 ft. by 30 in. conical mill as regards capacity, efficiency, and pebble consumption. Moreover, it ran throughout the test with its shell horizontal, while the operator of the conical mill found it necessary to elevate the feed end of his machine $1\frac{1}{2}$ in. to secure satisfactory operation, thereby introducing an undesirable thrust against the discharge trunnion-bearing.

A. W. CATLIN.

London, August 27.

RECENT PRACTICE AT ANACONDA.

Coal-fired Reverberatories. New Methods of Charging. Great Falls Converters.

By E. J. CARLYLE.

Coal-dust firing.—Since the development at Anaconda of reverberatory furnaces 100 ft. and more in length, and the subsequent use of oil-fuel in such furnaces in the Southwest, no innovation in the reverberatory matting of copper ore has aroused such wide-spread interest as the application of coal-dust firing,

About three years ago the Canadian Copper Co. built two furnaces in their plant at Copper Cliff, Ontario, and, thanks to the strong convictions of David Browne, installed the necessary equipment for firing with pulverized coal. The results were gratifying from the very first* and confirmed E. P. Mathewson at



COAL DRYING AND PULVERIZING PLANT AT ANACONDA.

and longitudinal charging, to one of the large furnaces at Anaconda.

The advantages of this form of fuel were appreciated over twelve years ago by some of the cement manufacturers, and its rapid adoption in this industry attracted the attention of steel men. They, too, found it profitable to use coal-dust, applying it to puddling, re-heating, and, in some cases, to open-hearth steel furnaces.¹

Sorensen at the Highland Boy,² and Shelby at Cananea,³ both experimented with coal-dust as fuel for reverberatories, but, while impressed with its possibilities, they were for various reasons unable or unwilling to make it a permanent feature at those plants.

¹'The Use of Pulverized Coal in Metallurgical Furnaces.' James Lord *et. al.* Proc. Eng. Soc. of Western Penn. Oct., 1913.

²*Eng. and Min. Journal*, Feb. 10, 1906.

³'Cananea Reverberatory Practice.' By L. D. Ricketts. Inst. of Min. and Met., Nov. 18, 1909.

Anaconda in the belief, which he had for some time entertained, that it would pay to use coal-dust there.

The success of this method of firing depends upon the following essentials:

1. The coal before it is pulverized must be dried until the total moisture present is less than 1%.

2. It must be finely pulverized. At most plants 90 to 95% of the dust will pass through 100 mesh, and from 80 to 85% through 200 mesh. Friable coals when pulverized thus finely will contain a large proportion of material far too minute to be measured by any screening method. C. D. Demond, head of the research department at Anaconda, has examined certain samples of coal-dust by elutriation and microscopic measurement, and reports one case in which 78% of the particles

*See discussion on Lord's paper by Rawlins.

were 0.004 mm. or less in diameter. He estimates that one pound of such material presents a surface of 20,970 square feet!

3. The coal used must contain sufficient volatile combustible matter to ensure the combustion required. I have found records of coal-dust containing from 22% V.C.M. upward. James Lord recommends 30% as a minimum. The Diamondville coal used at Anaconda contains

| | | |
|------------------------------|-----|-------|
| | | % |
| Moisture | ... | 6.8 |
| Volatile Combustibles | ... | 39.2 |
| Fixed Carbon | ... | 44.7 |
| Ash | ... | 9.3 |
| B.T.U. per pound | ... | 12075 |

4. The burner mechanism must be susceptible to delicate adjustment and control.

The Anaconda installation has been designed with a view to immediate extension, and consists of the equipment described herewith:

The coal is discharged from the storage-bin into a 30 by 30 in. Jeffrey single-roll coal-crusher reducing to 1 in. maximum, and passes thence on a belt-conveyor over a Ding magnetic pulley in order that any pieces of iron, bolts, etc., present may be removed. It is then elevated and fed by gravity into a 40 ft. by 6 ft. 8 in. Ruggles-Coles drier. This drier consists of two concentric cylinders of which the inner is the shorter. To the outer surface of the inner, and the inner surface of the outer, cylinder are affixed ribs or blades of angle-iron so arranged that as the machine revolves, the coal, fed into the space between the cylinders, is continually lifted and dropped on to the inner shell, and at the same time advanced toward the discharge of the drier. The hot gases from the fire-box are drawn by a 72 in. Sturtevant fan forward through the inner shell and back through the annular space to the stack. The tabulated statement in the next column indicates the capacity and fuel consumption of this machine when treating coals containing various proportions of moisture. From the drier, the coal is elevated and conveyed to the dry-coal bin situated in a separate building along with a Raymond 5-roll pulverizer. This machine is rated at an output of four tons per hour of coal-dust, of which 93% will pass through 200 mesh. It would appear to a millman to be in principle a form of Huntington mill provided beneath the crushing compartment with a space into which air enters and rises through the machine. This rising current of air selects such of the particles as it can lift, carries them to a conical

POUNDS COAL REQUIRED TO DRY 1 TON OF COAL IN 80 IN. BY 40 FT. RUGGLES-COLES DRIER.

| Moisture % | Capacity tons per hr. | Pounds of coal per ton dried | Speed of Drier | Speed of Fan |
|------------|-----------------------|------------------------------|--------------------------------|--------------|
| 5 | 40 | 18 | 6 r.p.m. | 250 r.p.m. |
| 6 | 35 | 20 | | |
| 7 | 32 | 22 | | |
| 8 | 29 | 25 | Using a 72-in. Sturtevant fan. | |
| 9 | 26 | 27 | | |
| 10 | 24 | 30 | | |
| 15 | 16 | 45 | | |

settler, and discharging them there, returns to the pulverizer. Obviously the velocity of this air current through the pulverizer determines the size of the product. This velocity can be regulated precisely.

From the settler, the dust is conveyed to the hoppers over the burners. These burners are made by the Sturtevant company. Each consists of a short spiral conveyor placed above, and parallel to, an air-pipe entering a port in the back wall of the furnace. The coal-dust is carried by the spiral to an opening through which it falls on to the inner cone, and is injected into the furnace. The air is supplied to the burners by a No. 11 Buffalo fan, delivering 5000 cubic feet per minute at 8 oz. pressure. A secondary supply of air is drawn into the furnace-ports by natural draught through adjustable dampers. Both primary and secondary air supplies can be regulated. The coal-dust supply, of course, depends upon the speed of the small spiral conveyors, and this speed can be regulated with the utmost nicety by a Reeves variable speed regulator. An adjustment once made is maintained indefinitely. If the furnace foreman has to shut-off the burners for any reason, he does so by releasing a clutch. When he re-engages this clutch, the burner resumes firing at the original adjustment.

Some of the advantages of this method of firing are:

1. The fine fuel burns so readily that a smaller excess of air over that theoretically required is sufficient.

The Copper Cliff engineers find that only 150% of theoretical air is required. With grate-firing under the best conditions 200% is needed. For a given amount of coal burned as dust, therefore, at least 12% less air than that required in grate-firing must be raised to smelting temperature.

2. When coal is burned on a grate not less than 10% of the heat is lost from the grate through radiation, heat in clinkers, etc. With coal-dust firing all of the fuel is burned over the furnace-hearth.

3. Owing to the smaller volume of air needed and the absence of grate-friction, less draught is required. Consequently, the hot gas remains in the furnace longer, and so imparts more of its heat to the charge.

4. Higher temperatures can be attained, and that too, at the point where they are needed. Both the rate of combustion and the distance from the burner at which it becomes complete can be precisely regulated.

For a person seeing coal-dust burn for the first time, it is difficult to realize that solid fuel is being burned. The stream of dust and air looks like a jet of dark gas igniting as silently and completely as producer-gas.

With ordinary precautions the dust is easy and safe to handle. All parts of the installation are carefully enclosed, so as to prevent leakage of dust, and there are no pockets or recesses in which the coal-dust can accumulate and remain stationary. These safeguards obviate the possibility of dust explosions or spontaneous combustion.

I do not know the cost of drying, pulverizing, and firing coal at Anaconda. The published records of several other companies, however, indicate that these three operations can be done for 2s. per ton or less.

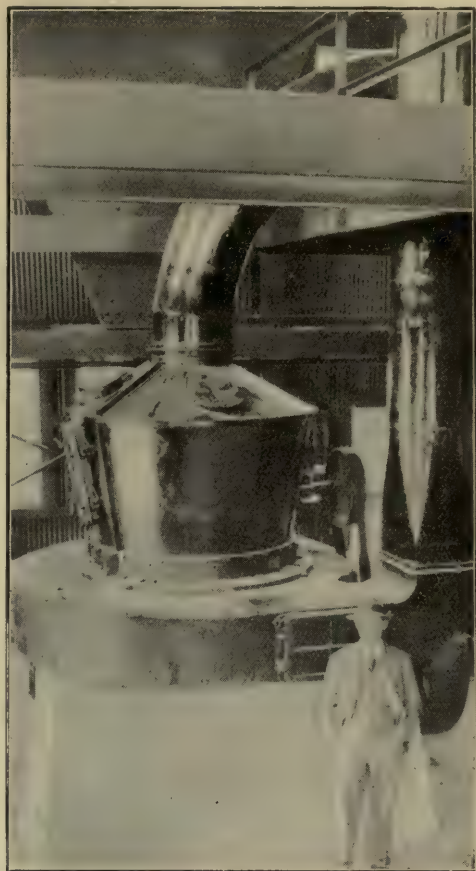
The remodelled furnace is 124 by 20 ft. inside, and ranges in height from 8 ft. 3 in. at the back to 5 ft. 6 in. at the skimming end. In place of the somewhat complicated side-walls that used to be built to withstand the cutting action at the slag-line, this furnace has sides built like simple retaining walls. Since 'claying' or fettling is no longer done—as will presently be explained—these side-walls have been built without doors. For inspection of the furnace interior, a few small apertures have been provided and a view of the entire furnace can be obtained through the burner-ports.

The gases from the furnace are led through flues to either of two batteries of Stirling boilers, each developing 600 h.p. Some misgivings having been entertained by the staff as to the ash accumulating in these flues, the one that will be most used has been enlarged from 3 by 4½ ft. in cross-section to 5 by 8 ft. So far no difficulty has been met in removing the ash deposited in this flue, and none is now expected.

For years the practice in charging reverberatory furnaces has been to drop the calcine through four hoppers close to the fire-bridge. Part of the material floated forward on the bath, smelting as it advanced. The remainder stayed in a heap under the hopper until fused.

The furnace-gases, therefore, imparted heat to a given charge with a speed that, other things being equal, depended largely upon the surface presented by that charge.

The new practice at Anaconda is to maintain banks of calcine for 75 ft. along the sides of the furnace. In the cross-section, repro-



THE RAYMOND COAL-PULVERIZER.

duced herewith, will be seen the two lateral hoppers in which the hot calcine is received. These hoppers discharge through 6 in. pipes, LL, spaced 19½ in. apart. The centre hopper shown was provided for experimental purposes.

This charging practice has developed, so far as I can learn, by the following stages:

1. At Cananea (see preceding foot-note) openings in the furnace-roof were provided to facilitate fettling. Silicious ore was dropped through these openings from a car on a mono-rail above.

2. Forest Rutherford, superintendent of the Copper Queen plant at Douglas, Arizona,

| Date. | | Tons charged. | | Tons coal burned. |
|---------|-----|---------------|-----|-------------------|
| June 2 | ... | 548'9 | ... | 59'4 |
| " 3 | ... | 384'7 | ... | 60 |
| " 4 | ... | 317'6 | ... | 60 |
| " 5 | ... | 337'6 | ... | 60 |
| " 6 | ... | 189'8 | ... | 58 |
| " 7 | ... | 329'6 | ... | 62 |
| " 8 | ... | 513'3 | ... | 62 |
| " 9 | ... | 357'2 | ... | 62 |
| " 10 | ... | 383'8 | ... | 62 |
| " 11 | ... | 389'0 | ... | 63'5 |
| " 12 | ... | 397'6 | ... | 64'8 |
| Average | ... | 395'4 | ... | 61'25 |

W. H. Howard has also been experimenting with this form of fuel. At this plant the furnaces were all formerly fired with oil, using, I believe, 0'7 barrels of oil per ton of charge. I understand that Mr. Howard considers that the dust-fired unit shows a decided gain over that fired with oil.

Converting.—All the converting at Anaconda until recently was done in 13 stands. These will be replaced shortly by four 20-ft. Great Falls converters. One vessel of this type, shown in the photograph, is already in service. This converter was first charged on December 14, 1913. Up to June 1, 1914, it



20-FT. GREAT FALLS CONVERTER AT ANACONDA.

Since completing the above notes I have received a communication from Anaconda, dated August 1, stating that the furnace when fired with the Diamondville coal, mentioned above, had attained the capacity of 500 tons of charge per day, smelting 7'5 tons of charge per ton of coal, and that even with Belt coal—a cheaper fuel containing 20% ash, 25% volatile combustible, and 35% fixed carbon—the furnace treats 420 tons of charge, smelting 5'5 tons of charge per ton of coal.

It is only fair to mention that at Garfield,

had been in operation 134 working days, and had treated 222'98 tons of 45'3% matte per working day. During May it averaged 233'91 tons of matte per working day. On occasion it has treated over 300 tons of 42% matte in 24 hours.

As it has been fully described*, I need only mention the principal dimensions: At the tuyere-level the vessel is 20 ft. in diameter outside, and 15½ ft. inside the lining. It is

*Bulletin, A. I. M. E., Aug., 1913. "Great Falls Converter Practice." By A. E. Wheeler and Milo W. Krejci.

16 ft. in height and has a mouth 8 ft. in diameter. The magnesite brick lining of the bowl varies in thickness from 30 in. at the tuyeres to 15 in. at the front; that of the roof is 9 in. over the greater portion and 4 in. at the back.

The tuyeres originally used at Anaconda were of 2½ in. diameter. They gave trouble, especially when the blast-pressure varied suddenly, by throwing large quantities of matte out of the mouth. One-inch tuyeres were then tried, but proved too small. Those now used are 1½ in. diam. and give satisfaction. The next shell installed will be equipped with 1¾ in. tuyeres, and the staff anticipate improved results with that size.

In charging, 4 to 5 tons of flux (copper ore containing about 62% silica) is fed by the crane. Then trains coming from the reverberatory or blast-furnaces pour about 85 tons of matte through a short launder into the converter. The vessel is in an upright position with the blast on while being charged, and the air-pressure is increased gradually as the bath deepens. During the blow, flux is added as required until the iron is eliminated. No slag is poured until the white-metal stage is reached. The converter is then skimmed clean, 500 to 1000 lb. of copper-scrap added and the charge blown to blister copper. At all stages of the blow, care is taken to maintain a coating of iron oxides on the brick lining. On the skill with which this is done depends the life of the lining.

It seems to be easier to keep the tuyeres open than it was with the old acid-lined shells. Two or three punches during a blow are sufficient. After finishing a pour all of the tuyeres are carefully reamed out. Any that need replacing are removed by turning the vessel over into the pouring position and pulling the tuyeres out with the crane. Sometimes a good tuyere will be plugged with copper for from 4 to 12 inches of its length. The procedure in such a case is interesting. A tank of compressed oxygen (of which large quantities are made by the company for use in welding, etc.) is fitted with a hose terminating in a section of ½ in. iron pipe. A gentle stream of the gas is permitted to flow through this tube and the end of the pipe is ignited. The pipe is then thrust into the tuyere and the oxygen turned on full. The intense heat resulting from the combustion of the iron fuses the copper in a few seconds. This method is also used in opening chilled tap-holes in reverberatory furnaces and blast-furnace settlers.

Lead and Zinc.

We take the following figures for the production and consumption of lead and zinc throughout the world during 1913 from the reports of the Metallgesellschaft, of Frankfort. The figures for the production relate to the smelters' output and not to the metal contained in the ores mined in each country.

| LEAD. | | |
|------------------------|----------------------------|-----------------------------|
| | Production metric tons. | Consumption metric tons. |
| Europe— | | |
| Spain | 203,000 | * |
| Germany | 181,100 | 223,500 |
| France | 28,000 | 107,600 |
| Great Britain | 30,500 | 191,400 |
| Belgium | 50,800 | 42,900 |
| Italy | 21,700 | 32,600 |
| Austria-Hungary | 24,100 | 35,500 |
| Greece | 18,400 | * |
| Sweden-Norway..... | 1,500 | * |
| Russia | 1,000 | 58,800 |
| Turkey..... | 13,900 | * |
| Holland | — | 9,500 |
| Switzerland | — | 5,800 |
| Other countries* | — | 6,300 |
| Total Europe | 574,000 | 713,900 |
| North America— | | |
| United States | 407,800 | 401,300 |
| Mexico | 62,000 | * |
| Canada..... | 17,100 | 22,900 |
| Total North America | 486,900 | |
| Japan..... | 3,600 | 18,500 |
| Australia | 116,000 | 9,600 |
| Other countries* | 6,200 | 30,000 |
| Total for World..... | 1,186,700 | 1,196,200 |
| ZINC. | | |
| Europe— | | |
| Germany— | | |
| Rheinland-Westfalia... | 92,852 | |
| Silesia | 170,119 | |
| Total | 283,113 | 232,000 |
| Belgium | 197,703 | 76,400 |
| Holland | 24,323 | 4,000 |
| Great Britain..... | 59,146 | 194,600 |
| France & Spain | 71,023 | 86,900 |
| Austria & Italy..... | 21,707 | 51,300 |
| Russia | 7,610 | 33,300 |
| Norway | 9,287 | * |
| | 673,912 | |
| United States | 320,283 | 313,300 |
| Australia | 3,724 | * |
| Other countries* | — | 20,900 |
| | 997,900 | 1,012,700 |

GEOLOGY APPLIED TO MINING. IV.

By T. A. RICKARD.

*FROST is a geologic agent of prime importance. The disintegration of rocks by weathering is due largely to the fact that water has its maximum density at 39° F. Therefore, it expands on being further cooled. This expansion, when it culminates, at 32°, the freezing point, is "sudden and of overwhelming strength"¹; it becomes a powerful lever for disruption whenever water seeps into the crannies and crevices of the rocks, and subsequently becomes subject to such rise and fall of temperature as marks the difference between day and night. Those of you who have done any mountaineering or have even rambled among the high hills will have wondered why you so rarely see fragments of rock in the act of falling, although the enormous slopes of debris or talus testify eloquently to a process constantly in operation. At one time I used to think that the reason why we rarely catch Nature in the act, as it were, of throwing stones, is because the disruptive effect of frost on rocks is at its greatest intensity when we are asleep, that is, at dawn or just before day-break; but this is not a satisfactory explanation, for the actual detachment and fall of rock usually takes place after the sun has diffused his warmth, late in the morning. That is the time when the mountaineer has to be on the alert, not only as against showers of stones, but against the deadly avalanche or snow-slide. No, the talus is one of many geologic effects representing the cumulative effect of a slowly operating natural process. Any one man in the course of his life may not often see the rock falling down a particular cliff, because the interval of a generation is barely a unit of geologic time.

Those who live in temperate climates have learned to regard ice as the evidence of an ephemeral variation of temperature connected with seasonal changes, but there are parts of the earth where the frost reigns supreme throughout the year, where the summer thaw is superficial, and the ground is frozen for hundreds of feet below the surface. It is the sequel to a Glacial period, that is, a time when the winter cold exceeds the summer heat, so

that the ground is never loosened from the bonds of ice. Such is the case now at either Pole, and such a condition existed, we know, over large portions of the earth's surface, not only in the period just preceding the appearance of Man, but even during earlier geologic ages. In Australia there was a Glacial period in Permian time; in South Africa, before the Carboniferous. During these Glacial periods, continental areas were covered under a blanket of ice, which, on a milder climate supervening, retired in the direction of greatest cold, usually, but not always, one of the Poles, leaving the surface once more exposed to the mollifying influence of the sunshine. Then came a time when the summer heat thawed the ground deeper than the winter cold could penetrate; during each successive warm season the thaw extended farther, until at last all the ancient frost was melted and these parts of the earth's crust were completely liberated from ice, except occasionally and superficially during the winter. The distinction is between the permanent ice of a geologic period and the evanescent frost of a terrestrial season.

As man came after a Glacial period, so men followed the ice age in its retreat. In his search for gold, the prospector was destined at last to invade the very fastnesses of the Ice King.

When the miner penetrated into the northern valleys of Alaska and Siberia, he found gold in deposits of gravel as in regions nearer home; but a new experience was thrust upon him, for the alluvium was frozen hard. It had to be broken or thawed before he could extract the gold. A pick is helpless against a bank of frozen gravel; dynamite freezes when placed in contact with ice. One other method remained: to imitate Nature. With an ingenuity that is never baffled for long, the digger proceeded to thaw the gravel, so that it might become amenable to his customary operations. When the Yukon was invaded in 1898 by a horde of excited and inexperienced gold-seekers, they found that the pioneers had already developed a simple method of unloosening the gold in placer deposits. They placed a bundle of sticks on the ground and made a fire that melted the frozen gravel. Then, with pick and shovel, they dug a hole. This hole, as the result of repeated thawing and digging, became a shaft, which, finally, by aid of a rough wind-

*The fourth of a series of five lectures delivered at Harvard University in May 1913, and at the Royal School of Mines in January 1914.

¹J. Tyndall. 'Forms of Water.'

lass and bucket, reached to the bedrock, where lay the richest layer of gold-bearing sediment. This might be at a depth of 10 or 20 feet, but it might be at one or two hundred feet. The ground was found to be frozen all the way, that is, the moisture had turned to ice, cementing the gravel.

In the first winters of that great rush to the Yukon, the valleys of the Klondike presented scenes worthy of a Gustav Doré! A weird silence broods over the waste of snow. The gloom is thickened by a pall of smoke escaping from holes in the ground whence also come and go the dark figures of the workers. The flare of fires, parting the twilight, marks the beginning of shaft-sinking. There is no noise, for there is no machinery; no whistles announce the noon-hour or the evening rest; there is no drilling in hard rock or cheerful hammering. Not many of the workers are visible, for most of them are below in the rabbit warren of their diggings. Only here and there, a weary gnome may be espied turning a windlass or emptying a bucket from a black pit in the snow. Strange shadows are thrown athwart the gloom. The snow and the moss muffle every foot-fall, deaden every sound. It looks like hell—but it is freezing.

The discovery that started the famous rush to the Klondike was made by George Carmack on August 17, 1896. Carmack was a fisherman, mated to an Indian squaw, and running a frontier trading-post on the Yukon. Happening to be short of fresh meat, he went with three Indian companions on a hunting expedition up Bonanza creek. This is a tributary of the Klondike, which itself enters the Yukon river where the city of Dawson now stands. Carmack knew that four white men, under the leadership of Robert Henderson, were prospecting on the other side of the watershed, so he crossed the divide and sold them some of the moose-meat that he had secured. Henderson and his friends were not getting much gold, but Carmack saw what they were doing and got the idea of prospecting. Returning, he began to look around, and on passing down Bonanza creek he actually found gold on a rim of bedrock projecting above the stream. He located a claim, and so did each of the Indians with him. These locations were immediately recorded at Forty-Mile. But the fact created no excitement until the prospectors at Forty-Mile remarked that Carmack's gold was unlike that of their own locality: it contained more silver. Therefore, they inferred, the story was not a fake. Whereupon others went to

Bonanza creek and also found gold-bearing gravel, some of which was so rich as to yield them a fortune. Thus began the golden age of the Far North.

The first discovery of gold in the Yukon was made, as we have seen, where the running stream had exposed the edge of a rich layer of gold-bearing sediment lying upon the rim of a deeper channel. This channel marked the bed of an earlier stream, now buried under the detritus deposited by floods during a much later period. The smaller creek of today does not follow exactly the course of the earlier stream, but it runs in the same valley, so that the living water now flowing down the gulch modifies—in places assists and in other places impedes—the extraction of the gold lying upon the older and deeper channel. This gold, in turn, came from a still earlier fluvial deposit, now mostly eroded, and that deposit again was a concentration from a more ancient and much larger river-channel, of which suggestive remnants have been found on the upper slopes of the hillsides bordering the present valley. Here we have a series of geologic chapters recorded as in a book to those that care to read. I have endeavoured to summarize the story in the accompanying diagrammatic sketch.

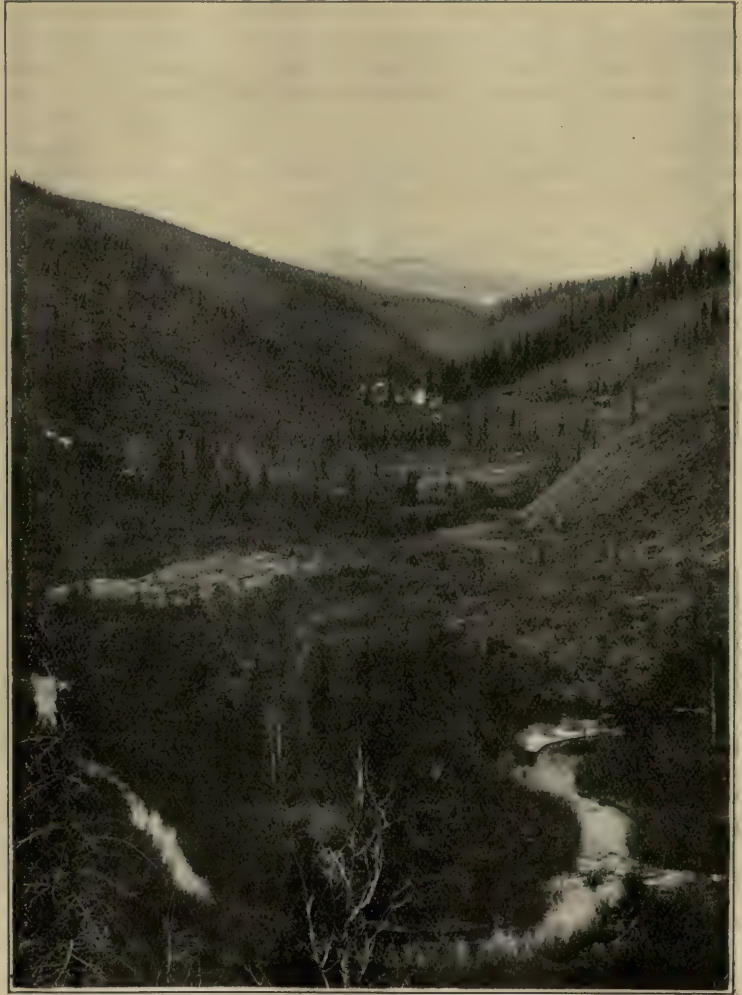
After the rich deposit in the creek was discovered, and most of the available ground had been located, the diggers rambled over the adjoining hillsides and found patches of gold-bearing gravel, the surviving remnants of a Pleistocene channel of large dimensions. Still higher was a more imposing deposit, a terrace of gravel now known as the White Channel, on account of the predominance of white quartz pebbles. This is a mass of Pliocene drift, as much as 200 feet thick in the exposures that have been exploited, but it must have been much thicker in the central portion of its channel, now eroded. The age of these deposits has been ascertained by fossils and correlation. The agency that made them and then unmade them was not ice. Glacial action cannot be invoked, although it has been suggested. Geological evidence suffices to prove that the Klondike region was not glaciated nor the larger part of Alaska, save in the higher mountains, although, with this exception, the whole of Canada, in late geological time, was under moving ice. No; the rounded ridges and flat-bottomed valleys of the Klondike goldfield are due to the sculpturing of a softer hand than that of ice.* The light-coloured

*Preliminary Report on the Klondike Gold Fields. By R. G. McConnell, Ottawa, 1900. Geol. Surv. of Canada.

flaggy sericite schist, traversed by a multiplicity of small gold-bearing quartz veins, has been eroded by water, which has also been the agent in that process of concentration whereby the gold has been collected along the natural sluice-boxes and the rocky riffles of the creek-beds.

The uppermost alluvium, that of the White Channel, was originally a river deposit, formed during the Pliocene period. At the close of the first process of deposition, a regional depression caused a change in the watershed. Previously the local drainage had flowed into the Stewart or the Twelve-Mile valleys; then it broke into the present valley of the Klondike, building a wide band of gravel, so that the White Channel increased to a thickness of about 200 feet. Again, a change of level ensued, the period of depression being followed by an uplift, giving renewed erosive force to the streams, which proceeded to deepen their channels until they had cut through the old gravel. Indeed, the uplift (attaining a maximum of 700 feet) continued so long that the rapidly flowing streams cut into the bed-rock itself for a depth of 150 to 300 feet. The narrow steep valleys formed at this time are seen to cut across the older ones, whose wide flats and gently sloping sides are in strong contrast. Most of the White Channel was swept away, only isolated terraces surviving. In these remnants, large to the miner, but small to the geologist, the gold diminishes rapidly in quantity and coarseness from bedrock upward,* so as to suggest the re-concentrating action of successive streams. Ordinary descent by gravity was hindered by frost, for the climate became more severe after the period of deposition.

All the other alluvial deposits are the children of the White Channel. Parts of it were eroded and re-deposited during the Pleistocene period, forming an enriched deposit of which remainders have been found on rocky shelves, midway between the White Channel and the creek-beds of today. Indeed, nearly all the



THE VALLEY OF GOLD CREEK, A TRIBUTARY OF THE KLONDIKE. A TYPICAL TOPOGRAPHY BEFORE MINING OPERATIONS STARTED.

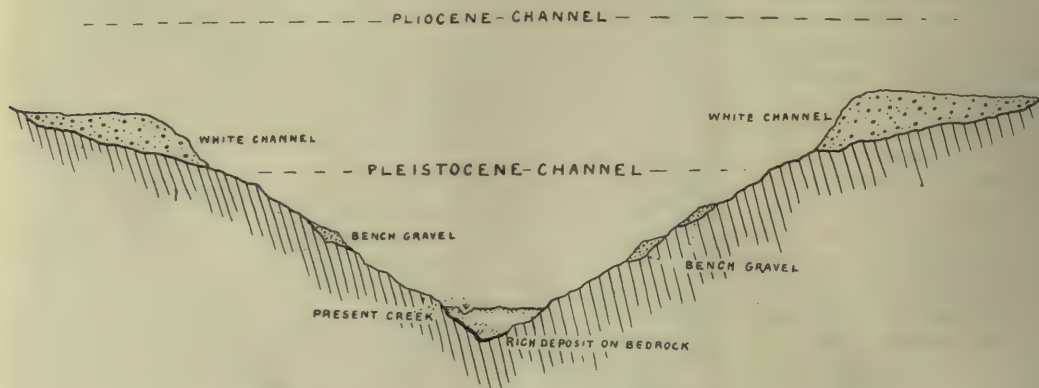
gold of the present low-level valleys is of secondary origin and derived from the re-distribution of the older gravels. The extraordinary richness of such creeks as Bonanza and Eldorado is attributable directly to the fact that above them the White Channel has been entirely destroyed, and its gold contents have been washed into the narrow valleys threaded by the small creeks that yielded so

* Report on Gold Values in the Klondike High-Level Gravels. By R. G. McConnell. 1907.

rare a harvest in 1898 and 1899. Bonanza creek, as an ore deposit, therefore, is a recent concentrate, by weathering and washing, from pre-existing gravel deposits of relatively great antiquity.

This interpretation of the facts came in the wake of mining operations. At first only the creek-bed was prospected. Those who started to look for gold on the hillsides were derided as simpletons. And, indeed, they were ignorant. It was no scientific inference that led to the first discovery of the bench-gravel; it was an accident: the sort of accident that sometimes does reward search however unsystematic. The experienced miners did not think of looking for gold anywhere except in the creek-bed; they laughed at the *cheechako** or 'tenderfoot' who knew no better than to extend his prospecting to the barren hillside.

thawing process of wood-fires was applied. The sub-Arctic valleys were stripped of their stunted forest, and only in the protected hollows did trees grow at all. It was a laborious method of loosening the gravel so that it could be washed in the 'sluice-box,' 'rocker,' and 'long-tom,' but it had its advantages, especially when working in the creek-bed. In sinking a shaft through the overburden of barren, or nearly barren, flood-gravel, it is customary in temperate regions to encounter water and soft ground, necessitating both pumping and timbering. In frozen ground neither is required, so that the frost, at first a serious obstacle, has proved a real friend to the miner in the north: it enables him to work without timbering; it allows him to burrow with impunity and to follow the layer of golden gravel with safety under the ice-bound



IDEALIZED CROSS-SECTION OF BONANZA CREEK, YUKON.

But the experienced man was wrong, because his experience was limited, while his generalization was not. Here we have an example of ill regulated empiricism: the argument that a thing cannot be because a particular person has never seen anything just like it. If he knew reasons why it could not be, that would be a scientific deduction. The other is mere rule of thumb. The argument from personal experience is as narrow as the individual knowledge of the various forms of gold occurrence. No metal is found in so great a variety of ore deposits and under geologic conditions of such extreme diversity. A little knowledge is a dangerous thing. "The scientific *ars artium* is to be able to say: I don't know." As Huxley remarked.

All of these gravel deposits—in creek, bench, and terrace—were frozen solid. To each the

covering. In this way and by these methods the diggings on the Klondike and its tributary creeks yielded a rich harvest of gold, and excited the stampede that aroused the attention of the civilized world in 1897 and 1898.

The method of thawing by means of wood-fires was fairly effective, but it was slow, disagreeable, and expensive. It was a new application of an ancient practice. Before Columbus discovered America the miners of central Europe employed the process known as 'fire-setting.' A fire was built close to the face of a mine-working, and when the rock had become thoroughly heated it received a douche of water, thrown from a pail or bucket. The sudden expansion of the water in the crevices of the hot rock caused it to crack. When thus fractured, it became easy to extract the ore with wedges and hammers. The introduction of powder and dynamite put an end to this ancient practice, which, for ex-

* 'Cheechako' is a Chinook word meaning 'newcomer.' It is a synonym for inexperience.

ample, lingered in the Kongsberg mines of Norway until 1884. In 1891, when in charge of the silver-lead mines of Grand Clos, in the Dauphiné, I climbed into the abandoned upper workings, which are situated in the precipitous face of an Alpine cliff and had not been visited by an engineer for at least a century, to find that the face of the *galerie* was beautifully concave, because it had been excavated by fire-setting. In the lower workings we were using machine-drills and dynamite. The contrast was vivid.

picked up the exhaust-pipe, which was a rubber hose, and applied it elsewhere within reach. Thus he ascertained that the steam thawed the overburden of ice and moss to a depth equal to the full length of the hose within a few minutes. This excited him and the other men who happened to be watching the experiment. Each of them set to work devising a scheme for applying the idea. A rifle-barrel was chosen, and near one end a small hole was bored in the side for the admission of the steam. That end of the tube



BONANZA CREEK, SHOWING THE WHITE CHANNEL (A, A), THE BENCH DEPOSITS (B, B), AND THE CREEK WORKINGS (C, C).

Dynamite, of course, could not be used effectively for breaking gravel cemented by ice; and wood-fires, as I have said, proved unsatisfactory. The smoke and gases liberated from the unseasoned wood called for vigorous ventilation such as was impracticable in workings that usually had only one outlet. But necessity is the mother of invention. One of the pioneers at Dawson hit upon the idea of employing steam for the purpose. In 1898 Charles J. Berry noticed that the steam escaping from the exhaust of his hoisting-engine had thawed a hole in the ground. He

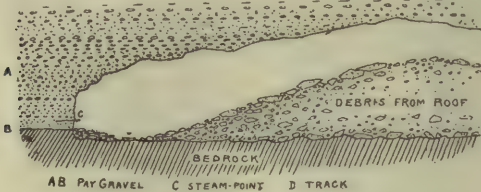
was plugged so that the other end might be driven into the ground by the blows of a hammer. Thus the 'steam-point' was invented.

In its rudimentary form the steam-point was an iron pipe, pointed at one end, where the steam issued, and attached near its other end to a rubber-hose connected with a boiler. The pointed end was inserted into the frozen gravel and driven forward gently by taps from a hammer as the ground became softened by the steam. Later, a solid head was placed upon the end that received the hammer-blows and a protective ring was welded to the forward

end; armoured tubing replaced the ordinary hose, and the body of the instrument itself was made of pipe of special manufacture. By these steps the miner evolved a tool of great efficiency for a special purpose.

The length of the steam-point ranges from 6 to 16 feet, the usual size being 8 to 10 feet. This is driven home so as to make a bore about 6 feet deep, the point being turned by a bar inserted through a hole in the solid head of the instrument. As the operator hits the head with a hammer, held in one hand, he also turns the point by means of the bar, held in the other hand. In a 20-ft. deposit, using 'points' 12 feet long, it is possible to thaw 4 or 5 feet deep at each setting. Thus the cost of thawing gravel, at first as much as 30 cents per cubic yard, was reduced to 14 or 15 cents.

The efficiency of the method will vary according to the pressure of the steam, the distance between the 'points,' the time allowed for steaming or 'sweating,' and the proportion of ice in the ground. Obviously, it is well to

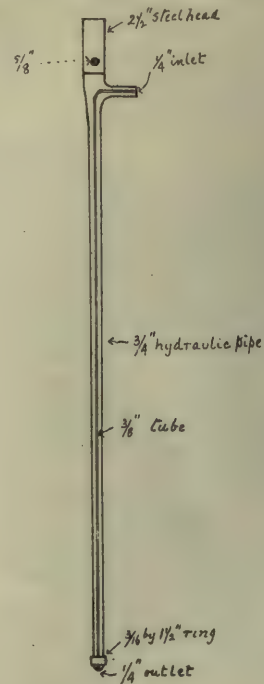


A TYPICAL STOPE IN AN ALASKAN DRIFT MINE.

place the 'points' at such distances apart as will avoid overlapping of the spheres of influence or areas of sweating, which range from 2 to 2½ feet. By giving the steam sufficient time (from 24 to 30 hours) to perform its duty, the area thawed is enlarged. The greater the amount of humidity, in the form of ice, the more the quantity of heat required to overcome the latent cold. The slowness with which ice melts is measured by the fact that it requires as much heat to melt one cubic foot of ice as would raise the temperature of a cubic foot of water 176°F.

The first discoveries, as we have seen, were made along the edges of the running stream, where it exposed the rim of a former channel. It was soon ascertained that the gold-bearing gravel extended under the present creek-bed and that the deeper deposit marked the course of an earlier river system, now buried beneath an overburden of detritus containing but little gold as compared with the concentrated layer lying on the true bedrock. Either the whole of the overburden had to be removed or underground excavations had to be made. The latter

method was much the more economical. Shafts were sunk to the old river-bed, and galleries were extended along bed-rock for the extraction of the rich sediment lying thereon. This method is termed 'drifting.' A 'drift' mine is a subterranean alluvial mine. At first the excavations were made by thawing with wood-fires, the extraction of gravel underground during the nine months of winter being followed in the summer by three months of washing the gravel that has been accumulated at surface. When the steam-point was introduced, extraction was continued throughout the summer as well. A battery of steam-



THE STEAM-POINT.

points would soften the face of gravel in a fraction of the time required by a laborious succession of fires.

The typical stope in a northern drift mine is a low cavernous opening, with the air of a cold-storage chamber. Along one side, in the darker layer of gold-bearing sediment, is a series of steam-points, with only their heads visible, and with nothing to indicate the process at work, for all leakage of steam is prevented as far as possible. Not only does a leak mean a waste of energy, but the warming of the air by escaping steam is apt to thaw the roof and cause a fall of ground. While the silent process of thawing is in operation in one part of the mine, the removal of thawed

gravel, by means of pick and shovel, will be in progress in another portion of the workings. About one foot deep of bedrock is removed with the five or six feet of rich gravel, for the gold is found lying in the cracks and crevices of the schistose bedrock, which, however, is so decomposed that it can be excavated as readily as the overlying sediment. Here all is bustle and energy. No men work so magnificently as do the miners in these northern diggings. Each man swings his pick vigor-

He may receive a tap on the shoulder from a falling stone, to remind him that mining is dangerous as well as profitable.

The steam-point having been used successfully underground, in drift mining, it was applied at surface to the thawing of placer deposits preparatory to dredging. At first the digging of the shallow alluvium by bucket-dredges was limited to areas already thawed by the sun. Such areas were much restricted, for in sub-Arctic regions the surface is carpet-



THAWING WITH STEAM IN FRONT OF A DREDGE.

ously, and, having shovelled the gravel into a wheelbarrow, he waits until the other members of the gang, 8 or 10, have also filled their barrows; then, led by a picked stalwart, they trundle their barrows in procession to the shaft, where each empties his burden into the bucket, to be hoisted to the surface as soon as it is full. On the other hand, in the workings where the steam-points are preparing the ground for the miner's attack, the visitor walks through silent chambers, the only sound being a rare sizzle of steam from an imperfect pipe-joint, or the occasional dropping of a lump of gravel loosened by the warming of the air.

ed with moss, which serves as an insulating blanket protecting the ground underneath from the heat of the sun. The word 'heat' is used advisedly; in July a temperature of 90° is often registered at Dawson. When the use of the steam-point was developed, it became the practice to remove this mossy covering by hand, or by means of scrapers pulled by horses. Then the 'points' are driven into the frozen gravel and steam is admitted. The more ice there is in the gravel the greater the consumption of heat required in converting water from its solid to its liquid state. In the accompanying photograph you will see a battery of steam-points

at work in Bonanza creek in front of a dredge, which is shown in the background. To the left is the house containing the steam-generating plant, consisting of three boilers, fired by wood at \$8 per cord delivered, the steam-gauge registering a pressure of 150 pounds. By the time the steam reaches the place where it escapes into the gravel the pressure has been reduced to 25 pounds. In the foreground is the complicated system of piping connecting the 'points' with the boiler. The main pipe-line is enclosed in a wooden conduit packed with sawdust, as an insulator. The minor pipes are wrapped in asbestos packing. When starting, it is customary to prepare a way for the steam-point by driving a 1½-inch steel bar into the ground until the gravel is reached. Then the bar is withdrawn and the steam-point substituted. The rate of thaw is about 2 feet per hour. By this method the ground is thawed at a cost of 12 to 15 cents per cubic yard.

This is an expensive method, for it more than doubles the cost of dredging. The question arose, therefore, whether the natural thaw in summer could not be utilized by first removing the moss and so giving the sun a chance. If the winter frost did not undo the previous summer's thaw, then a succeeding warm season might cause a deeper softening of the ground, and so obviate the need for artificial thawing. This brings us to a detailed examination of the causes producing a Glacial frost.

The surface is covered with moss; not the soft carpet of tender green familiar to those in lower latitudes, but a coarse, insistent, and rough growth of exuberant thickness and toughness. It is rooted in a layer of frozen vegetal matter, called 'muck' by the miners, simply because when thawed it disintegrates into a black slime that floats readily on the running stream; because 25 to 40% of it is organic matter, and the rest is water. The thickness of this vegetal matter varies from a few inches to 40 feet, the maximum being found in gullies where it has accumulated by sliding from adjoining hillsides. Two feet is an average thickness. Whether thick or thin, this insulating layer, with the upper covering of moss, must be removed before the seasonal thaw can affect the frozen gravel underneath. This is done in places naturally by freshets or meandering streams; it can be done artificially and systematically by ground-slucing and hydraulicking. When stripped of its Arctic covering, the frozen gravel is readily thawed. We have seen how this is done by the use of steam-points, at a cost of

15 cents per cubic yard. Can it be done otherwise and more cheaply? Yes, by observing the operations of Nature. In the Yukon the summer, that is, the interval free from frost, lasts 120 days. During the long days, when the sun barely goes below the horizon, the temperature is relatively high, ranging from 50° to 90°F. Then the surface becomes a quaking morass, and where the moss has been removed the thaw penetrates to a depth reaching from 4 to 8 feet, according to local conditions. On the other hand, the winter frost penetrates from 3 to 6 feet only, depending upon the natural thickness of protective snow-fall early in the season. The maximum thaw observed in the Yukon is 27 feet in 2 years, at the mouth of Bear creek, in coarse gravel, and the maximum frost is 6½ feet in one winter. Thus, on average, where the ground is exposed, the summer thaw will penetrate deeper than the winter frost, reversing the conditions that obtained during the Glacial period. Even in the coldest of recent winters, such as that of 1905, when the thermometer fell to -71° F., the frost did not overtake the previous summer thaw, on ground that had been stripped, by 3 feet. Thus it has been ascertained that in two summers the frost in a gravel deposit may be conquered by the natural thaw to a depth of from 12 to 16 feet; that is, where bedrock is not more than 12 to 16 feet deep, it is practicable to thaw the gravel to bedrock in two summers by simply removing the overburden of moss and mould. Hence, by taking advantage of this fact, the cost of thawing by steam-points can be obviated, at an expense of time. The problem can be stated in figures. An acre of gravel 18 feet deep contains 27,649 cubic yards containing, say, 45 cents worth of gold per yard, making \$11,059'60; if thawed by steam, the cost is about \$4100; if thawed slowly by exposure to the sun, the loss of two years at 5% on \$11,059'60 equals \$552'98 per annum or \$1115'96 altogether. As compared with steam-thawing, this is cheaper by about \$3000 (it figures, in this example, exactly \$2984'04) or about 11 cents per yard. It only remains to say that this method, based upon the understanding of the superficial geologic conditions, has already been applied successfully, and is destined to be an important factor in the exploitation of northern alluvial deposits.

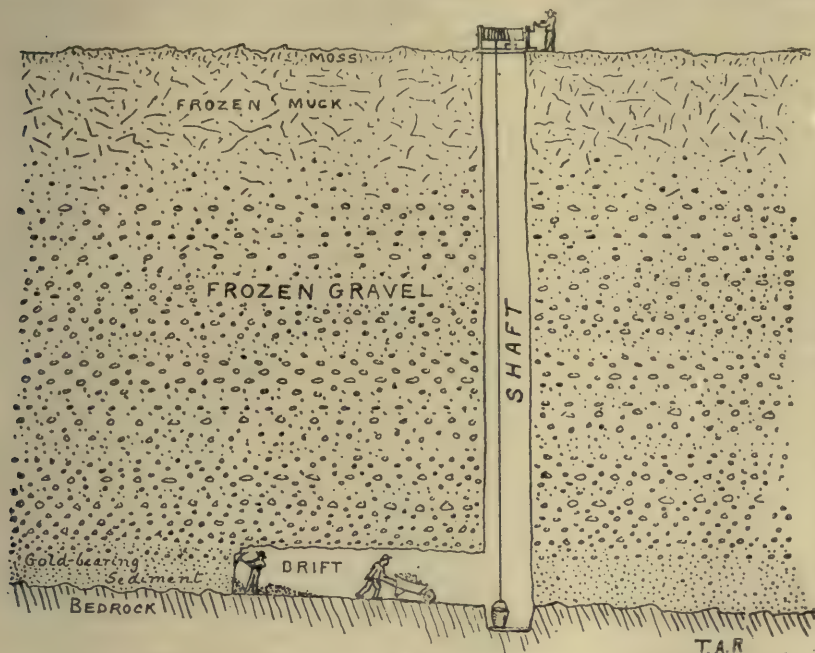
The low thermal conductivity of ice is the fact underlying the conditions governing mining in the North. It also explains the warmth of an *igloo*, the snow-hut in which the Eskimo

lives. The interior is kept warm by the animal heat of the inmates and by a central lamp of seal-oil. As the warmth thaws the inner wall, it becomes immediately re-frozen by the adjoining cold snow. Another illustration, more immediately appertaining to mining, is the method by which a ditch is kept open in the severest winter. The power-plant of the Granville Mining Co., near Dawson, is operated by the water flowing through a ditch 6 miles long. This ditch is filled with water at the beginning of winter; and a cover of ice, 18 inches thick, is allowed to form on top of the water. At the same time the sides of the ditch are sealed by the frost, stopping the

method was originated by J. W. Boyle, one of the Klondike pioneers and a man of keen observation.

The deep penetration of frost is an interesting geological fact. In the Chantanika valley, which is in the Fairbanks district of Alaska, a shaft was sunk 315 feet to bedrock, and was in frozen gravel all the way. Even this depth has been exceeded in Spitzbergen, an island, as you know, 400 miles north of Norway and 800 miles within the Arctic circle. Spitzbergen is a *terra nullius*, or no man's land, for it is not subject to any recognized government; however, even this fact has not prevented an enterprising American, John M.

Longyear, from developing a mineyielding bituminous coal of the highest quality. His mining operations, under the name of the Arctic Coal Co., have demonstrated that frost can penetrate to a great depth. At the face of the main entry, an adit 2200 feet long, the nearest surface is 800 feet overhead. At this vertical depth of 800 feet, the ground is frozen, and the seams of coal are separated by extremely thin sheets of ice that look like plate-glass. The amount of ice is slight, for the coal contains only 1½% moisture. The underground temperature, summer



A DRIFT MINE IN FROZEN GRAVEL.

leakage so troublesome in summer. Then the level of the water in the ditch is lowered, so that, in effect, it runs within an ice conduit. Further, to guard against a sudden lowering of temperature, a resistance-coil made of telephone wires, and looking like a set of bed-springs, 5 ft. wide and 8 ft. long, is placed in the ditch at intervals of two miles. By the passage of an electric current of low voltage, generated at the power-station by the water itself, it is kept from freezing, and even when it issues from the ditch into the open penstock it remains unfrozen during the coldest weather. By these means the power-plant was kept running even in January when the thermometer registered 60° of frost. This ingenious

and winter, is 22° to 23°F., as determined by boring holes 6 feet deep into the rock, leaving a self-recording thermometer for 24 hours.

This, of course, is the sequel to a Glacial period. Similar evidence of a former epoch of excessive cold has been obtained, for instance, in Colorado. At the Stevens mine, above Silver Plume, in the Rocky Mountains, a shaft was sunk over 200 feet in rock that was frozen all the way, as shown by the fact that all the moisture in the ground had become ice. So also at the Silver Pick mine, on Mount Wilson, in the San Juan region of Colorado, the ground is frozen to the maximum depth attained, namely 700 feet.

These are suggestive facts. How did the cold penetrate so deeply, and how much deeper may it be supposed to penetrate? Frost involves moisture, for we are speaking in terms of water. Dry rock exhibits no visible sign of cold. Rock and water are both poor conductors of heat, as compared with the metals.* Yet, of the two, water is a better conductor than rock. Hence moisture increases the conductivity of rock, or, what is more correctly termed the 'thermal diffusivity,' namely, the rate at which changes of temperature are propagated in any material. This diffusivity was ascertained by Kelvin to be the ratio of the thermal conductivity to the thermal capacity of unit volume. Rainfall has been found¹ to raise the value of the diffusivity in soils. Earlier experiments² had verified the inference that water was favourable to the transmission of heat. Absolute thermal resistances have been determined as follows:

| | Dry. | Wet. |
|--------------|------|------|
| Clay..... | 400 | 270 |
| Pumice | 1616 | 863 |
| Brick..... | 556 | 300 |

It has also been ascertained that the thermal conductivity of rock is modified by its texture, the lighter and more porous rocks showing greater resistance to the passage of heat, as compared with the more compact and crystalline rocks. A comparison, in units of thermal resistance, is as follows:

| | | | |
|--------------|-----|----------------|------|
| Quartz | 104 | Slate..... | 253 |
| Granite..... | 176 | Shale..... | 425 |
| Basalt..... | 179 | Quartz Sand... | 1333 |

Hence the detritus and gravel constituting an alluvial deposit will check the conduction of heat, as compared with solid rock; but the presence of water in the gravel will tend to overcome its lesser conductivity, so that wet gravel will transmit heat as well as slate and shale, although not as well as granite and basalt.

Having regard to the low conductivity of rock, whether dry or wet, whether solid or fragmental, it remains an astonishing fact that frost should penetrate so deeply. Obviously the cold came from above downward, for in depth an increment of heat, normally 1° F. for each 90 feet of descent, is observed.

A downward limit to frost, therefore, is inevitable.

The ultimate depth to which frost will penetrate must depend upon the conductivity of the frozen rock, the mean temperature at the surface, and the rate at which heat escapes from the earth. Assuming the rate of escape of heat from the earth to be 1.63×10^{-6} calories per sq. cm. per sec., or 41 calories per sq. cm. per annum, and the average conductivity of the frozen rock to be 0.0058 C.G.S. (calories per sq. cm. per sec. for a temperature gradient of 1° C. per cm.), then for the frost to penetrate to a depth of 800 feet or 24,400 cm. would require a mean surface temperature t° C. below the freezing point, giving the equation

$$\begin{aligned} \frac{t \times 0.0058}{24400} &= 1.63 \times 10^{-6} \\ t &= \frac{1.63 \times 10^{-6} \times 24400}{0.0058} \\ &= 6.9^{\circ}\text{C below freezing point.} \end{aligned}$$

On the other hand, if the rock be frozen alluvium having a conductivity of only 0.0029, or half of an average rock, the mean surface temperature would have to be -13.8°C. for the same escape of heat.* Now, the mean air temperature of Spitzbergen is -8.3°C.¹ but the mean annual variation is from +12° to -40°C., so that at an earlier period the mean temperature may easily have been lower than the -13.8° mentioned in the second calculation. In any case, the workings in this coal mine are still increasing in their distance from the surface, so that 800 feet is not the maximum of frost penetration ascertainable. It is likely to extend much deeper. We have here another example of the slow operation of natural forces. The frost of a single winter may be superficial, but the persistent cold of a geologic epoch can exercise an influence more profound than we have imagined on the basis of our limited experience. We judge the past by the present, it is true; we infer what may have happened by what we see happening; but the geologist must make allowance for an element of vast consequence in the problems he is trying to solve. Time is of the essence of any geological hypothesis. Nature can draw a blank cheque on the bank of Time, and operates in periods so long that the coming and going of one of the generations of Man is but a comma on the pages of the geologic record.

*The thermal diffusivity of copper and ice are: Copper 1.108, Ice 0.0057.

¹'Observations of Soil Temperatures.' By Hugh L. Callendar. Trans. Roy. Soc. Canada 1895. The effect of water in raising the diffusivity of the soil depends partly on percolation, that is, convection, and partly on displacement of air, which is a particularly bad conductor.

²British Association for the Advancement of Science. 1881. Report of Committee on Experiments to determine the Thermal conductivity of certain Rocks.

*For these suggestions, I am indebted to Professor Callendar, now in the Imperial College of Science and Technology, London.

¹This is the mean of observations made during nine years, ranging from 1872 to 1912. For these facts I am indebted to Dr. G. Rempp, of Weissenburg.

PRECIS OF TECHNOLOGY

Magnetic Concentration.—The *Mining and Engineering Review* for July contains a description by Loftus Hills of the magnetic concentration plant erected at Launceston, Tasmania, for the treatment of complex concentrate produced at the Shepherd & Murphy tin mine, at Moina, near Wilmot. The ore at this mine, in addition to cassiterite, contains wolframite, bismuthinite, magnetite, pyrite, with small amounts of scheelite, the gangue being quartz and fluor-spar. Two grades of concentrate are produced, from the upper and sulphide zones respectively. The first class is docile to the ordinary treatment on Wetherill separators, but the second required considerable study, and a special preliminary treatment was devised by Mr. Hills.

The mineralogical analysis of the first-class concentrate in terms of percentage is as follows: Cassiterite 53.8, wolframite 29.5, bismuthinite 7, pyrite 2, magnetite 1, silica and fluor-spar 7.2. This is passed first through a weak magnetic field to remove magnetite, and then through a slightly stronger field to remove the pyrite. Passage through third and fourth fields removes the wolfram and produces a concentrate averaging 70% WO_3 and 0.7% tin. The remaining non-magnetic material averages 56.3% metallic tin, 8% bismuth, and 0.7% WO_3 . This is shipped to England, where it is treated for the recovery of bismuth and the residue sold to tin smelters.

The second-grade concentrate is more complex, having a percentage composition as follows: Cassiterite 26.6, wolframite 14, bismuthinite 8.4, pyrite, chalcopryite, and arsenopyrite 32.5, magnetite 1, monazite 2, scheelite 1.2, molybdenite 0.8, quartz and fluor-spar 12.5. It was at first intended to roast the concentrate and send it to the magnetic separators, but so much of the non-magnetic or slightly magnetic material came over with magnetic that no saleable products were obtained. After much experimentation it was found that good results were obtained by making a magnetic separation as before, roasting the two products, and giving the two sets of roasted material further magnetic treatment. In the preliminary magnetic separation the magnetite is removed first, and afterward a magnetic concentrate is obtained consisting of wolframite, with some pyrite, arsenopyrite, monazite, and quartz, and averaging 42% WO_3 , 1% metallic tin, and 2% bismuth. The non-magnetic residue contains cassiterite, bismuthinite, pyrite, chalcopryite, arsenopyrite, scheelite, molybdenite, quartz and fluor-spar, having a percentage composition of: cassiterite 31.6, scheelite 1.9, molybdenite 0.9, bismuthinite 10, pyrite, chalcopryite, and arsenopyrite 36.6, gangue 19, and an average assay of 23.7% metallic tin, 1.5% WO_3 , 0.9% molybdenic acid, 9% bismuth, and 0.34% copper. The wolframite product and the non-magnetic residue are then roasted separately, great care being taken not to volatilize the bismuth. The roasted materials are then sent to the magnetic separator. As regards the wolfram material, the three products obtained are: first, a product containing all the iron, a little wolframite, and the bismuth; second, wolframite with some monazite; and third, a non-magnetic product carrying the cassiterite and gangue. The wolframite product averages 64% WO_3 and is readily saleable. It is notable that bismuth goes over with the iron of the roasted pyrite. It is probable that in the sulphide zone some of the bismuth is chemically associated with the iron.

The roasted non-magnetic product is sent to the magnetic separator, where the iron of the pyrite, chal-

copyrite, and arsenopyrite is removed, and a product obtained having an average assay of 39% metallic tin, 2.5% WO_3 , molybdenic acid 1.5%, and bismuth 11%, and 29% quartz, etc. This material is treated on tables for the removal of quartz, and a final product obtained averaging 51.5% tin, 2.9% WO_3 , 0.5% molybdenic acid, and 12.5% bismuth. This is readily saleable in the same way as the tin-bismuth product obtained from the high-grade concentrate. The iron product containing bismuth is saleable for its bismuth content.

Paragenesis of Copper Minerals at Butte.—In *Economic Geology* for July, James C. Ray presents the first portion of the results of his studies with the microscope in connection with the paragenesis of the minerals in the covellite zone in the mines at Butte, Montana. By 'covellite zone' the author refers to the part of the lodes where massive covellite has been found, in conjunction with the principal minerals, chalcocite and enargite namely, at the Speculator, High Ore, Leonard, and Tramway mines. Among previous writers, Walter Harvey Weed has considered the covellite to be secondary, either derived from chalcocite or deposited under exceptional conditions in the crushed and clayey matter in fault veins; while Reno Sales believes it to be largely of primary origin if not entirely so, stating that its occurrence bears no relation to the surface or to the zone of alteration, and that the intimate association with enargite, bornite, and pyrite supports the primary view. Mr. Ray was fortunate in being able to study a large block of newly opened ore containing much covellite, on the 1600-ft. level of the Leonard mine. The quartz-monzonite of the walls is highly silicified and pyritized, and the joint planes have been filled with pyrite. Close to the vein the pyrite and to a less extent the silicates have been replaced by enargite, covellite, and chalcocite. Innumerable veinlets containing the same copper minerals traverse the country-rock near the vein, displacing each other and the joint planes. Quartz occurs along the upper part of the hanging wall, and inside it is an irregular zone of enargite; between the enargite and a horse irregular fragments of quartz and enargite ore are cemented, and appear to be partly replaced by massive platy covellite and a covellite-chalcocite mixture. In the foot-wall the quartz and enargite ore is represented only by broken fragments that are cemented with a matrix of covellite-chalcocite.

It is clear that there has been considerable movement in the vein since the beginning of mineralization, and a change in the species of copper minerals deposited from the solutions. From the evidences available without the use of the microscope the following inferences may be drawn: (1) There was an early period of quartz-pyrite mineralization; (2) the early quartz-pyrite filling has been fractured and at many places brecciation was followed by enargite deposition; (3) later movement fractured the vein and provided openings for the circulation from the solutions that deposited covellite; (4) the covellite is fractured, and chalcocite has surrounded fragments and eaten inward along the loosened plates of the covellite.

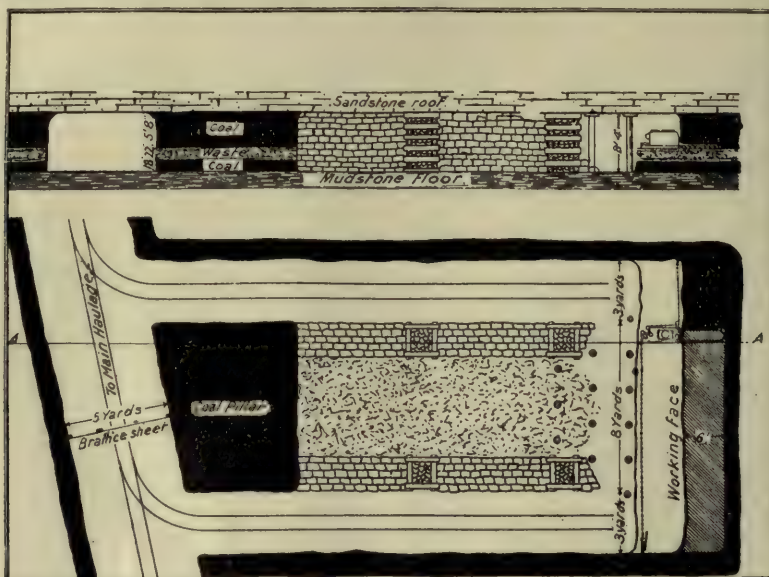
Mr. Ray then proceeds to consider the various phases of mineral formation in detail. A study under the microscope of the wall-rock taken a foot from the vein shows that sericite and secondary quartz comprise 80 to 90% of the silicates, with the remainder principally unreplace quartz and feldspar of the original quartz-monzonite. Tiny veinlets of copper sulphides follow in a general way the distribution of the earlier pyrite, and the disseminated grains of pyrite

are also replaced to a great extent by the later sulphides. The sulphide veinlets cut through masses of sericite, primary and secondary quartz, and fragments of felspar. Nearly the whole of the sulphides is chalcocite, which encloses residual fragments of pyrite, enargite, and covellite, thus proving that the solutions at the several periods of copper mineralization were active in the wall-rock. Some disseminated kaolinite is found in the wall-rock, but its association with the sulphides is not such as to suggest simultaneous formation. Mr. Ray considers that the kaolinite was formed at a much later period, perhaps partly since the commencement of mining operations.

As regards the quartz-pyrite or first phase of ore deposition, there is no indication of minerals other than quartz and pyrite having been introduced in the covellite zone. Subsequently to this phase, and after a reopening of the vein, enargite was introduced by ascending solutions, and its distribution is general

solutions that deposited chalcocite was along the contacts between the earlier minerals, quartz, pyrite, enargite, and covellite, and the replacement of the mineral units did not begin until the rimming with chalcocite was complete.

The chalcopyrite and bornite in the ore are shown by the microscope to have been derived from pyrite held in enargite and covellite, during several successive replacements, and their formation to have been directly associated with the pyrite. The author's conclusions are that chalcopyrite and bornite were contemporaneous with the first generation of chalcocite, and that they were formed by the resorption of the residual pyrite by the chalcocite while the latter was in a colloidal state. The sections show the presence of a second generation of chalcocite. The author promises further contributions relating to the minerals of the covellite zone, and to the minerals of other parts of the deposits at Butte.



WONTHAGGI COAL MINE : ROOM AND PILLAR SYSTEM AT NO. 9 SHAFT.

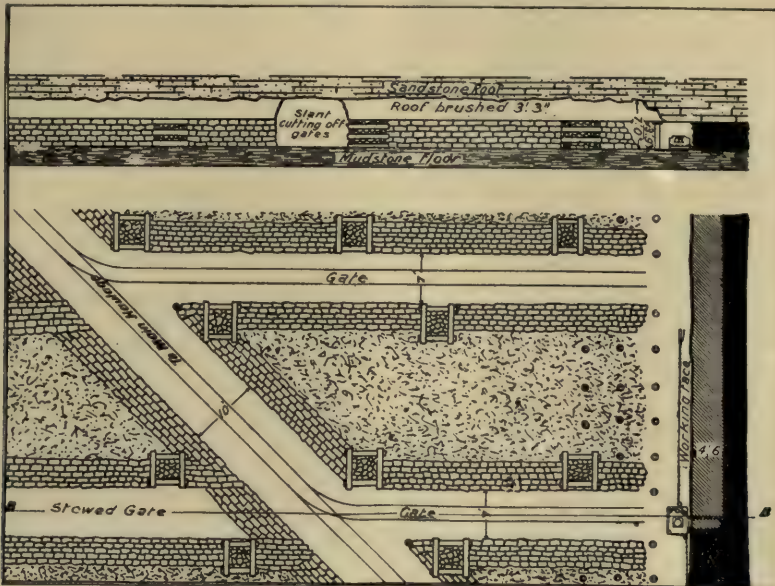
throughout the covellite zone, where it is found as a partial replacement of the quartz and pyrite. Practically all the enargite found in the covellite zone shows inclusions of quartz and pyrite. The next phase was the introduction of covellite after another reopening of the vein and partial brecciation. Sections and slides show that covellite is the principal mineral of the matrix surrounding the earlier quartz-pyrite and enargite depositions, and that it has replaced the earlier minerals. Generally the covellite is shown to be a replacement of enargite, and to a smaller extent of quartz and pyrite. In the replacement action, the covellite has more often replaced the enargite that was a replacement of pyrite than that which replaced quartz. In the wall-rock, covellite is also found to be a replacement of enargite.

As already mentioned, covellite is not the most important mineral in the covellite zone, enargite and chalcocite occurring in preponderating quantity. The relation of chalcocite to covellite is discussed by Mr. Ray. The microscope shows that chalcocite was the last mineral to form, and that it is always a replacement of the earlier sulphides. The first attack of the

Coal Mining in Victoria.—In *Mine and Quarry* for April, M. Brodie and P. T. Milligan describe the mining methods at the Wonthaggi coal mine in Victoria. The coalfield is in the Powlett River district, not far from the coast, and 80 miles southeast of Melbourne. The Wonthaggi has been worked by the State of Victoria and is under the management of the Railway Department. The area is about 5000 acres, and half has been thoroughly prospected by drills, nearly 400 bore-holes having been put down. The borings have proved 26 million tons of coal, and recently a bed at a lower horizon has been discovered, estimated to provide a further $1\frac{1}{2}$ million tons. Boring is being continued over the remainder of the property. The seam is at an average depth of 235 ft. from the surface and varies from $2\frac{1}{2}$ to 6 ft. in thickness. The seam is much dislocated by faults. The hanging wall is in some places sandstone and at others soft wet shale; the support of the roof presents many difficulties in consequence. The present workings cover an area of 650 acres, and have been developed from twelve shafts. Hoisting is done through Nos. 5, 9, and 10 shafts. The coal-handling plant is situated

at No. 5 pit, and the coal raised through the other two shafts is carried by electrically-driven endless rope to this station along the surface. The last yearly output recorded was 460,000 tons, of which practically the whole was sent to the railways. Owing to the irregularity of the seam, it is necessary to vary the method of mining to suit the circumstances. As is shown in the illustrations, the seam is worked by the room-and-pillar system at No. 9 shaft and by the longwall system at No. 10 shaft. In both cases the Sullivan electric cutters are employed. At No. 9 shaft the coal is 8 ft. thick separated by a band of waste 22 in. thick, and 18 in. from the floor. The method of working is by double stall, with stalls or rooms 42 ft. wide, and two gates with a track in each. The coal is first mined on the top of the waste, the length of

and sedimentary rocks, and Tertiary intrusive rocks in the form of dikes and stocks. The oldest pre-Cambrian are those of the Idaho Springs formation, a quartz-mica schist, considered to be a metamorphosed sediment. This schist is intruded by pre-Cambrian granites of two ages, the older having been changed dynamically to a granite-gneiss. Pegmatite off-shoots from both of these granites are numerous, and in some places intrude the schist so intimately as to produce an injection gneiss. Where the schist lies near or is enclosed by considerable bodies of granite, it has usually been contact-metamorphosed into hornblende schist. All these pre-Cambrian rocks are intruded by dikes and stocks of monzonite porphyry and bostonite porphyry of Tertiary age. The mineral veins cut both the pre-Cambrian and Tertiary rocks. They are the



WONTHAGGI COAL MINE: LONGWALL SYSTEM AT NO. 10 SHAFT.

the undercut being 6 ft., and the top 5 ft. of coal removed. The band of waste is then lifted and thrown into the gob, and lastly the lower $1\frac{1}{2}$ ft. of coal removed. In the No. 10 shaft working, the coal is thinner, averaging 3 ft. 9 in., so that the longwall system has been adopted. A gate 7 ft. wide is provided every 33 ft. for handling the cutter and loading the coal, and the space between is packed, in the manner shown, to support the roof.

Pitchblende in Colorado.—Professional paper 90A, by Edson S. Bastin, published by the United States Geological Survey, contains an account of the geology of the pitchblende deposits found at Quartz Hill, Gilpin county, Colorado. This is the only locality in the United States where pitchblende has been found in any important quantity as a constituent of mineral veins. As regards other parts of the world, similar deposits of note are found in Cornwall and the Erzgebirge. In many ways the geologic relations at Quartz Hill differ from those in Europe. Before giving an outline of Mr. Bastin's paper, we may mention that the Quartz Hill deposits were described by Forbes Rickard in the *Mining and Scientific Press* for June 7, 1913.

Predominant at Quartz Hill and the neighbouring parts of Gilpin county are pre-Cambrian igneous

result of combined fissure filling and replacement along a series of fractures, which are characterized usually by steep dips. On the basis of mineral composition they can be divided into two types, the pyrite and lead-zinc. They have been worked principally for their precious-metal content, though yielding also considerable amounts of copper and lead. The principal minerals in the pyritic veins are pyrite and quartz, with chalcopryrite, tetrahedrite, and pitchblende in subordinate quantities, while enargite, fluorite, and rhodochrosite are found here and there. In the veins of the lead-zinc type the minerals in order of importance are galena, zinc-blende, pyrite, chalcopryrite, quartz, and calcite. The occurrence in places of pitchblende in the pyritic veins is considered by Mr. Bastin to represent merely a local and unusual variation in the main sulphide mineralization of the region. This mineralization is held to be genetically connected with the Tertiary monzonite and to have taken place within a short interval after the intrusion of the monzonite. The veins of the pyritic type are considered as having been formed earlier than those of the lead-zinc type, and the pitchblende to have been deposited with the sulphides in the pyritic veins. Afterwards the lead-zinc veins were formed in fractures, some of them passing through the pyritic veins. In this way

it will be seen that Mr. Bastin differs from Mr. Forbes Rickard, who in the article quoted above presented evidence that the pitchblende veins were genetically connected with the pre-Cambrian granite. Mr. Bastin gives some drawings of slides taken from sections, to explain the paragenesis of the minerals in the veins. In a number of specimens it is evident that the pitchblende crystallized contemporaneously with chalcopyrite, and probably with minor amounts of pyrite, and grey quartz. He also calls attention to the fact that no nickel or cobalt is found at Quartz Hill, thus presenting a contrast to the deposits of Erzeberg and Cornwall.

Selling Silver-Lead Ores.—In the *Mining and Scientific Press* for August 11, L. S. Austin reviews the contracts made between the mines and smelters in the Salt Lake district for the sale of silver-lead ores and concentrates. He quotes the present basis of the contracts, and discusses the modern methods of smelting and the cost of each step, finally presenting a proposal for a revised system of payment. His remarks on the usual contract are instructive, and are worth quoting in some detail. We do not reproduce his own proposition on this occasion, but will defer until opportunity has been afforded for discussion by those interested. Payment for gold is made at the rate of \$19 per oz., leaving a margin of \$1.40 as compared with the price of standard gold \$20.40. No payment is made for gold content below 5 dwt. per ton. Payment for silver is based on 95% of the current New York quotation, but 1 oz. per ton is deducted. Lead is paid for at 90% of the New York quotation, from which is deducted 1½ c. per lb. No payment is to be made if there is less than 5% in the ore. The deduction of 10% is to cover the loss of lead in smelting, due not only to the losses in slag, but to the volatilized lead. The bag-house today prevents the volatilization loss. The deduction of 1½ c. per lb., or \$25 per ton, is to pay for freight and treatment. But it may be easily shown that this cost is \$18 only. The non-payment for less than 5% lead is a relic of days when lead was not so closely saved. Payment for iron is made at the rate of 7 c. per unit if the lead contents are over 30%; when from 30 to 25%, at 6 c. per unit; under 25% lead, at 5 c. per unit. Iron is paid for because of its fluxing value. The higher value set on it when the lead content is higher is to encourage the shipper to maintain that content. It has been realized by the smelting companies that the higher the lead the lower the slag-forming content of the ore. It is also possible that the smelter may be short of lead, which, as a collector, must be maintained to a certain ratio of the charge, preferably 10% at least. A charge is made by the smelter on insoluble content mostly silica at the rate of 12 c. per unit. The insoluble content is more easily determined and is higher than the actual silica, and so gives an advantage to the smelter. The charge is made because the silica must be smelted, not alone with the addition of iron worth 5 c. to 7 c. per unit, but also limestone at 90 c. per ton. Zinc, when less than 5%, has no charge against it, but over that figure the excess is charged at 2 c. per unit. Zinc, especially as blende, goes in part into the matte, in part into the slag, and in part is volatilized, making trouble in the shaft of the furnace, and carrying off some silver. With the bag-house it is believed that no silver is lost. However, due to its making trouble, it is penalized when it exceeds 5%. Arsenic forms speiss which, when in excess of 5%, is charged at 20 c. per unit. When a furnace is reducing well, speiss forms. It carries some silver and gold, and hence must be re-treated. Whether 20 c. per unit is a just charge or not is an open question:

it is a suspiciously round number. Sulphur is charged at 25 c. per unit up to a maximum of \$3 per ton. It has been assumed that \$3 is to cover the cost of roasting an ore of 12% sulphur or over. A treatment charge of \$1 per ton is made for an ore of 30% lead. For each unit of lead over 30% a credit of 5 c. per unit is allowed, and for each unit of lead under 30% a charge of 8 c. per unit is made. It is evident that the lead in the ore is greatly desired; also, as the percentage of lead increases, so the silica decreases, with a less production of slag. The figure of \$1 per ton for treatment is actually less than the actual cost, and this is done in place of giving the full price for the lead.

Dredging in New South Wales.—The annual report of the Department of Mines of New South Wales for 1913 just published gives particulars of the operations of the dredging companies working gold and tin gravel. The total number of bucket-dredges working on gold was 19 and of pump-dredges 12. Five bucket-dredges and 41 pump-dredges were working on tin. The 19 gold bucket-dredges treated 4,302,911 cu. yd. for a yield of £80,832, being an extraction of 4½ d. per yard. The 12 pump-dredges treated 711,197 cu. yd., for a yield of £16,750, being an extraction of 5½ d. per yard. The largest dredges are in the Araluen division. Here 8 bucket-dredges handled 2,230,821 cu. yd. for a yield of £40,548. The capacity of the buckets used varies from 4 to 6 cu. ft. The Victorian Araluen dredge with 6 cu. ft. buckets has a pontoon built entirely of steel. As regards the tin-dredging operations, the 5 bucket-dredges treated 579,391 cu. yd. for a yield of 201 tons of concentrate, being an extraction of 0.78 lb. per yard. The 41 pump-dredges handled 3,371,687 cu. yd. for a yield of 1618 tons, being an extraction of 1.07 lb. per yard. The largest tin dredge is that of the Y-Water company in the Emmaville district which digs to 50 ft. below water-line. During 1913 it treated 602,000 cu. yd. for a yield of 334 tons of concentrate.

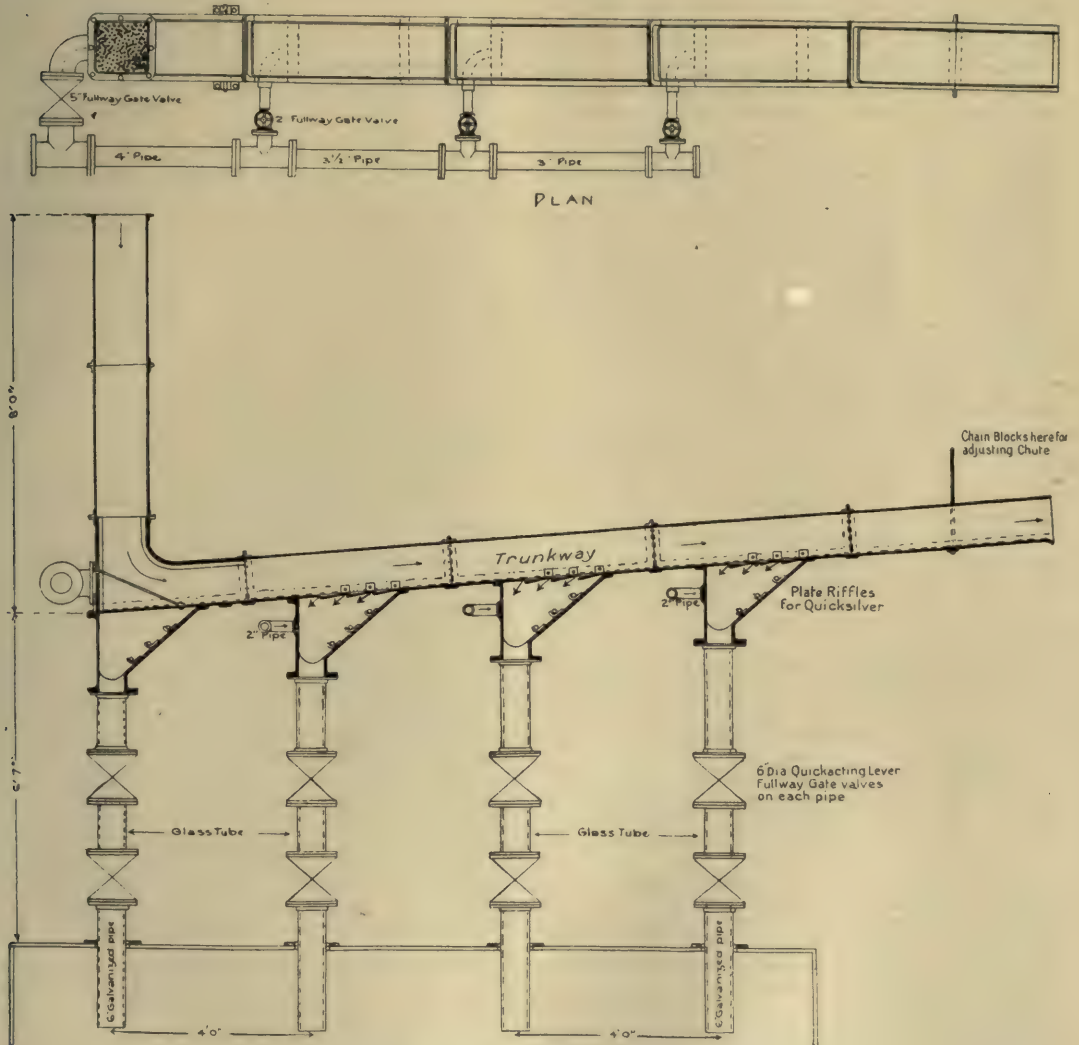
Hughes Alluvium Concentrator.—In the *Queensland Government Mining Journal* for July, E. Cecil Saint-Smith, Assistant Government Geologist, gives a report on a new form of apparatus invented by Rees Hughes, as a substitute for sluice-boxes, for saving the gold or tin in connection with dredging and hydraulicking operations. This apparatus is at work in the Stanthorpe tin district in south Queensland. The principle is similar to that of the Willoughby machine used for cleaning tin concentrate, that is to say, an upward pressure of water is employed sufficiently great to carry away sand and other light substances and allowing the heavier minerals to remain in position against the flow. A constant stream of water is injected upward, into a running stream of gravel, the pressure of the rising water being sufficient to carry the gravel while the heavier particles fall downward through it. The illustration shows a plan and elevation. The gravel is fed down the iron pipe, and passes along up the closed square iron boxes called the trunkway, which is set at an angle of about 20°. As the material falls to the bottom of the upright pipe it meets a stream of water under pressure issuing through a perforated steel grate. This water carries the material along the trunkway. The bottom of each box carries a hopper, and communication is made between the two by inclined riffles as shown. Water under low pressure is forced upward into these hoppers and between the riffles into the trunkway. The heavy metal or mineral escapes between the riffles into the hopper against the current of water. The space left between the riffles is usually about half-an-inch. The riffles are set backward, as otherwise they would be rapidly choked with gravel

and sand. A favourable feature of the apparatus is that when once the metal or mineral has passed into the hoppers it cannot be caught and carried away by clay-balls passing along with the gravel. In treating gold gravel, riffle plates carrying quicksilver are placed on the inclined walls of the hoppers. The discharge pipes below the hoppers have two valves each, whereby concentrate may be removed without interference with the operation of the apparatus. The part between

CURRENT LITERATURE

Gold Dredges in East Africa.—In the *Mining and Scientific Press* for August 1, Charles Janin describes the Bucyrus dredge built for the Andrada Gold Dredging company in Portuguese East Africa.

Huillard Dryer.—The *Iron & Coal Trades Review* for August 21 describes the Huillard dryer, intended for drying coal, ore, and similar material.



THE HUGHES ALLUVIUM CONCENTRATOR.

the valves is made of glass so that the progress of accumulation can be watched. The apparatus is mounted in such a way that the inclination of the trunkway may be varied to suit the conditions.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

Timber-Supply for Mines.—The *Iron & Coal Trades Review* for August 21, discusses the present scarcity of timber suitable for pit-props in the English coal mines and the many schemes for providing a substitute.

Slime Tables.—The August *Bulletin* of the American Institute of Mining Engineers contains a paper by Arthur Crowfoot, giving the history of the development of the round slime table in use at Great Falls, Montana.

Tin Losses.—At the recent meeting of the Australasian Institute of Mining Engineers, Hyman Herman read a paper giving his experience as regards losses of slime-tin during concentration operations at Tasmanian mines. His conclusion is that the vanning assay accounts for only half the tin in the tailing as disclosed by the chemical assay, but that the extraction cannot be substantially improved in practice by any mechanical method.

Leeuwpoot Tin.—The *South African Mining Journal* for July 4 gives an outline description of the tin-dressing plant at the Leeuwpoot mine in the Transvaal.

Short Tube-Mills.—In the *Mining and Scientific Press* for August 8, H. W. Harding relates early experiments on the short tube-mill and the evolution of the conical mill.

Zinc-Smelting.—The Annual Report of the Inspector of Alkali Works contains an important paper detailing experiments undertaken with a view to prevent the escape of zinc fume and zinc compounds into the atmosphere at smelting works. The government chemists undertook the investigation more particularly in connection with the works where the zinc dross from galvanizing plants forms the whole or part of the charge. The zinc chloride contained in the dross volatilizes and creates a serious nuisance in the neighbourhood of the plants.

Zinc-Smelting at Bartlesville.—In the *Mining and Scientific Press* for July 25, E. H. Leslie describes the zinc-smelting plant of the National Zinc Co. at Bartlesville, Oklahoma. The charging of the retorts at this plant is done by the Saeger machine. In the issue of August 8 the same writer describes the Collinsville smelter.

Porous Silica Filter.—*Metallurgical and Chemical Engineering* for August describes 'filtros,' a porous silica brick useful in many filtering operations, and applicable to the aeration of cyanide solutions according to the Just or Spilsbury process already described in our columns.

Continuous Decantation.—In the *Mining and Scientific Press* for July 18, Maurice Summerhayes describes the cyanide plant at the Porcupine Crown mine where the Dorr system of continuous decantation is employed.

Ore-Treatment at Cobalt.—In *Metallurgical and Chemical Engineering* for July and August, H. C. Parmelee describes the concentration and metallurgical plants at many of the silver mines at Cobalt, Ontario.

Copper Leaching.—The August *Bulletin* of the American Institute of Mining Engineers contains a paper by Stuart Croasdale detailing his experiments on the leaching of low-grade, partly oxidized copper ores in the Ajo mountains, Arizona. The same bulletin contains a paper by I. B. Joralemon on the copper deposits of this district.

Ore Deposits of Australia.—A series of articles by C. O. G. Lacombe on the ore deposits of Australia was commenced in the *Australian Mining Standard* for July 9.

Oroya Black Range.—The *Monthly Journal* of the Chamber of Mines of Western Australia for June contains an article on the geology of the Oroya Black Range ore deposits in the East Murchison goldfield.

Drumlunnon Mine.—The August *Bulletin* of the American Institute of Mining Engineers contains a paper giving a history of the famous Drumlunnon mine at Marysville, worked for so many years by the English company, the Montana Mining Co.

Sanitation in Cuba.—In the *Mining and Scientific*

Press for August 8, Charles F. Rand describes the steps taken at the Cuban iron mines for exterminating mosquitoes and the various fevers spread by them.

Mount Lassen Eruption.—In the *Mining and Scientific Press* for July 25, W. H. Storms describes the recent eruption at the ancient volcano, Mount Lassen, in Shasta county, California.

Salt Manufacture.—*Engineering* for August 21 describes the plant used at Carrickfergus, Ireland, in connection with the Tee process for refining rock salt.

NEW BOOKS

Recent Copper Smelting. Edited by Thomas T. Read: Cloth, octavo, 460 pages, illustrated. San Francisco, *Mining and Scientific Press*; London: *The Mining Magazine*. Price 10s. 6d. net.

It may be safely said without in any way prejudicing the many excellent text-books published in England and America that new treatises on the general metallurgy of any particular metal are no longer required by the men actually engaged in the extraction of metals from their ores. But though the metallurgical principles are well known, the art is still expanding, and the applications of mechanical and electrical engineering are of increasing importance. The copper metallurgist eagerly scans every periodical and professional paper as it appears. He may keep all these publications on his file, or he may make cuttings of what he requires. It usually happens, however, that he misses some individual paper, or he passes one by, not appreciating its value at the time. Months afterward he becomes aware of the incompleteness of his records, and seeks to fill the gaps, only to find that he is either not able to identify the original source of the article in question or that the paper is out of print. A few years ago the *Mining and Scientific Press* inaugurated a plan for republishing in book form all the articles relating to 'Cyanide Practice.' The book issued under this name achieved a quite unexpected success, and two other volumes have subsequently appeared, continuing the series with equally gratifying results both to the publisher and the public interested. It was suggested that a similar policy should be adopted in connection with literature relating to copper metallurgy, an art that has been progressing as rapidly as cyanide practice. The work of collecting the articles of lasting interest on the treatment of copper and its ores has been undertaken by Mr. Thomas T. Read, the associate editor of the *Mining and Scientific Press* in New York. Mr. Read is an expert in this subject on both the theoretical and practical sides, and not only is he intimately acquainted with American methods but he has had experience in European and far eastern practice.

The bulk of the matter composing this volume is drawn from the pages of the *Mining and Scientific Press*, a fact that proves the proximity of the great copper centres to San Francisco, the city where our contemporary is published, and also the close touch of our contemporary with the progress of copper metallurgy. It is impossible for us to devote the space necessary to describe the contents of the book in detail, for there are no less than 83 separate articles, all deserving mention. We are glad to see that Mr. Read has republished John Hollway's historic paper of 1879, wherein he described the first experiments leading to converter practice. He also reprints another classic paper, that by Lewis T. Wright on pyrite smelting. Reverberatory furnaces form the subject of many articles, by E. P. Mathewson and others, and modern practice with the converter occupies a large section of

the book. Dust-catching and fume-prevention, oil fuel, electric smelting, losses in slags, and analysis all receive attention. Special processes for the prevention of the escape of sulphurous gases, such as the Cottrell, thio-gen, and Hall, are described in detail. Though the title of the book specifies 'smelting,' Mr. Read has included advantageously much information relating to wet methods of copper extraction, adopted or tried in America during the last year or two. It will be seen from what we have said that the book will prove highly acceptable to all metallurgists.

E. W.

Concentrating Ores by Flotation. By T. J. Hoover. Second Edition. Cloth, octavo, 270 pages, with many illustrations. London: *The Mining Magazine*; San Francisco: *Mining and Scientific Press*. Price 12s. 6d. net.

It is just two years since the first edition of this book was published. Mining engineers and metallurgists have been unanimous in recognizing the high professional standard of the book and the help afforded by it in the study of concentration problems. Since its publication important modifications in the patent position have been caused by the decisions with regard to the Elmore patents in Australia and the Minerals Separation patents in one of the Appeal Courts in the United States. Moreover the principle of selective flotation has made a rapid advance. The time was therefore ripe for a revised and enlarged edition, and an idea of the progress of the art may be obtained from the fact that the edition now issued contains thirty per cent more pages than the first. The chapter on patent litigation is expanded by the inclusion of the judgments in the two cases mentioned above and of comment by this Magazine. The brief note in the first edition on the Horwood selective process has been extended and the results obtained by the Zinc Corporation are given in detail. The practice with the Hyde plant at the Butte & Superior mine is described. The principles and methods of the Lyster, Owen, and Bradford processes are described with plans and drawings, and the results quoted. The chapter containing the bibliography has been brought up to date. This is one of the notable features of the book, as it is probably the most complete index of books, articles, and references to any particular subject ever undertaken. We observe with satisfaction that the author has prepared an entirely new index. The index to the first edition was so full and detailed as to be diffuse and difficult to follow; whereas that to the second edition is smaller and more concise. As the author observes in the preface, a book treating a subject that is rapidly expanding is apt to become out of date as soon as it is published. We hope therefore that during the next few years, unless some radically new principle is discovered, he will give us separately published yearly supplements containing his own reviews of progress, selections of the most important articles, and bibliography of others. The same plan has been followed with Dana's 'System of Mineralogy,' and the scheme is similar to that pursued by the *Mining and Scientific Press* in connection with 'Cyanide Practice' and 'Copper Smelting.'

E. W.

Modern Steel Analysis. By J. A. Pickard. Cloth, octavo, 170 pages. London: J. & A. Churchill. Price 3s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Although we have already many books dealing with the analysis of steel, this latest addition will prove of considerable value to chemists interested in this branch of analysis. The book contains a selection of practical methods for the chemical analysis of steel, and

the author has endeavoured to condense into a small space, methods for the exact estimation of all the commonly occurring constituents of steel. The author has acted wisely is not attempting to give a comprehensive description of all the methods used, as this has been done already. Some knowledge of the manipulation necessary for conducting analytical determinations is assumed, but a section on general procedure is included, containing many useful hints that will prove of value to students who have been through a general course of analytical chemistry, but have had no experience in the routine work of laboratories. The same section contains sketches and details of several useful apparatus.

In discussing the methods for the determination of carbon, the author states, and seems to consider it a disadvantage, that in the wet-combustion method in which double copper salts are used, the carbon present in the steel as carbon monoxide or carbon dioxide is completely lost. In general, the difference thus caused would be within the limits of experimental error, and really should be considered as an advantage of the wet-combustion method from a practical point of view; for when the carbon contents are discussed, that present as carbon monoxide or dioxide is certainly not included. It is strange that in the methods of carbon determination, the author should state that copper potassium chloride is to be preferred to copper ammonium chloride for the separation of the carbonaceous matter, and then afterward give full instructions for making the copper ammonium chloride and not the copper potassium chloride solution.

In describing the determination of oxygen in steel, the author gives full details of his own method, taken from his Carnegie scholarship work, and describes no other method. A description of a method of combustion in hydrogen as more usually done in works laboratories would certainly have been useful. The book would not have lost in value by the omission of the mechanized methods of determining manganese and phosphorus.

In the appendix a useful table of analyses of steels, steel-making alloys, and alloy steels is given.

C. O. BANNISTER.

Metallurgy of Copper. By H. O. Hofman. Cloth, octavo, 560 pages, illustrated. New York and London: McGraw-Hill Book Co. Price 21s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

In a recent issue we reviewed at some length the 'General Metallurgy' of Professor Hofman, the first of a new series of books on metallurgy. On that occasion we credited the author with a profound knowledge of the literature of metallurgy, historically and currently, both American and German. Naturally the present volume is devoted almost entirely to American practice, for copper smelting is not one of the expanding industries of Europe. Besides his knowledge of the literature, Professor Hofman has a first hand intimacy with copper practice throughout the United States. Many of our readers may wonder at the issue of a new book in America on copper metallurgy, seeing that Dr. Peters affords so much opportunity for grasping the basis of operations. But we do not share this view, for more than one reason. For one thing substantial advances have been made during the past five years, and moreover Dr. Peters does not touch wet methods. We would indeed say that Dr. Peters has specialized on Anaconda blast-furnace practice, from the details of which he has been able to deduce the principles of the reactions in

his well known masterly manner. Professor Hofman has a compact literary style as compared with Dr. Peters' more discursive method, and consequently he has been able to collect within a small space a vast amount of general information. The chapters on reverberatory and converter practice, and on hydro-metallurgy are extremely useful at the present time. To put it briefly, Professor Hofman's new series forms an admirable monument for himself and for the Massachusetts Institute of Technology. We would also record our appreciation of the excellent work done by the publishers as regards the quality of the type and the printing, and the excellence of the illustrations.

Engineering Geology. By Heinrich Ries and Thomas L. Watson. Cloth, octavo, 670 pages, illustrated. New York: John Wiley & Sons; London: Chapman & Hall. Price 17s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The senior author of this book has more than a local reputation as an economic geologist, and has been professor at Cornell for many years. His previous books include 'Economic Geology of the United States,' 'Building Stones,' and 'Clays.' Mr. Watson occupies a similar position in the University of Virginia. Both of them during recent years have given courses of lectures to the civil engineering students, and they have collaborated to embody the lectures in the book now published. The subjects covered extend over a wide range; minerals, rocks, ore deposits, rock-weathering and soils, rivers, lakes, underground waters, glacial deposits, building stone, coal, clay, cement, petroleum and other hydrocarbons, etc. The examples are entirely confined to the United States, as is natural seeing that the book is intended for American students. Moreover the bibliographies at the end of each chapter include very few references to other than American publications. We regret that the authors have not made more reference of English technological literature, for, as a matter of fact, England is the home of engineering geology. As far back as 1837 the leaders of the Geological Survey recognized the value of the practical applications of geology by founding the Museum of Economic Geology, the forebear of the Jermyn Street museum, "to meet the wants of a great commercial and manufacturing community." It is remarkable how little known and appreciated are the services rendered in the past by English geologists in connection with railway construction, stone quarrying, water-supply, etc. Moreover a great many books have been published in this country on various branches of applied geology. But in spite of what an English reader may consider an incompleteness, the book is one of excellent value and will prove a useful guide to students of civil engineering.

Modern Practice in Mining. Vol. III. Methods of Working Coal. By Sir R. A. S. Redmayne. Cloth, octavo, 210 pages, illustrated. London: Longmans, Green & Co. Price 6s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Before Sir R. A. S. Redmayne was appointed Chief Inspector of Mines for the United Kingdom he was for a short time professor of mining in the Birmingham University. His previous experience was in connection with coal mining in the north of England and abroad. During the last five years three volumes (1, 2, and 4) of his series on modern practice in mining have been published, and now comes the fourth. The fifth and last is in preparation. The mining is entirely coal-mining. The present volume deals with the various methods of coal-winning. There is no new

information or novelty in treatment in this series, but it is an advantage to the student to be able to buy separate volumes devoted to the special subjects of immediate interest to him.

Electrical Practice in Collieries. By Daniel Burns. Fourth Edition. Cloth, octavo, 360 pages, illustrated. London: Charles Griffin & Co. Price 7s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

It is eleven years since the first edition of this book was published. The application of electricity to mining operations has advanced rapidly, and revised editions have been necessary in order to keep pace with progress. A large part of the book deals with subjects of equal interest to the metal miner. The first hundred pages is devoted to the outlines of the principles of electrical engineering, then follow chapters on lighting, pumping, haulage, hoisting, etc. Coal-cutting appliances and conveyors are treated in detail. The book is intended for students, and examination questions are added to each chapter. If it had been a general text-book we might have considered the chapter on hoisting incomplete from the point of view of modern requirements. We hope the author will improve his index in a subsequent edition.

Minerals and the Microscope. By H. G. Smith. Cloth, octavo, 120 pages, illustrated. London: Thomas Murby & Co. Price 3s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The author of this book is demonstrator in geology in the Imperial College of Science & Technology, South Kensington, and is a helpful instructor to the students of the Royal School of Mines. He is well aware of the many difficulties that assail the beginner in the study of petrology. Some of us have not got farther than an appreciation of these difficulties. Probably most of the masters of the subject have forgotten them. This book contains an excellent exposition of the details of microscopic investigation, and leads the reader by steps to a thorough knowledge of petrographic principles.

The Black Diamond Reader. By Henry Briggs. Cloth, octavo, 250 pages, illustrated. London: Thomas Nelson & Sons. Price 1s. 8d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is described as a primer of coal mining for schools and continuation classes, and the author is head of the mining department in the Heriot-Watt college, Edinburgh. The style of presentation of the subject reminds us of Hopton's 'Conversations between Father and Son,' a book that enjoyed great popularity in days gone by. The dramatis personæ in Mr. Briggs' book are the lads not yet started at work and the men of experience not only in the mine but in the battlefield. The information is given colloquially and in such a way as to impress the beginner with the nobility of his work and the responsibility of doing it faithfully.

Minerals of California. By Arthur S. Eakle. Cloth, octavo, 230 pages. Published by the California State Mining Bureau.

The first list of California minerals was prepared in 1866 by W. P. Blake, and a second in 1884 by H. G. Hanks. Since then the mineralogy of the state has been more fully investigated and the knowledge extended. The present edition is in hands equally able, the author being professor in the University of California and a well-known writer on mineralogy.

COMPANY REPORTS

Dolcoath Mine.—The report for the half-year ended June 30 of the premier tin mine in Cornwall affords gloomy reading. Developments at depth (3300 ft.) have disclosed no ore whatever, and recourse has been had to some of the outlying parts of the levels between 1800 ft. and 2940 ft. with little result as yet. The output of concentrate and the yield per ton was the smallest on record since the present company was formed in 1895; whereas 1015 tons was obtained from 28,717 tons of ore during the first half-year ended December 31, 1895, only 728 tons was recovered from 57,254 tons during the half-year under review, the produce per ton falling from 79 lb. to 28½ lb. In spite of this drop in grade the company might have made a divisible profit had not the price of tin been falling recently. The average price received for concentrate during the half-year was £92. 14s. as compared with £134. 13s. during the first half of 1913. But it must be remembered that in the years 1895 to 1898 the prices received for concentrate were far lower than have ruled since 1910, the average of the former years being less than £40 per ton. The total sum received from the sale of concentrate during the year was £67,544 or 23s. 7d. per ton. The gross profit was £5013, out of which £4502 went to A. F. Basset, the 'lord' or owner of the mineral rights, so that the company was left with a nominal profit of £510. No allowance has been made for depreciation. Malcolm McLaren has been conducting a geological investigation with the object of ascertaining the most promising places for future development.

Grenville United Mines.—The report of this Cornish tin-mining company for the half-year ended June 30 shows that 21,483 tons of ore was sent to the mill and 291 tons of concentrate extracted. This sold for £26,867. Owing to the recent gradual decrease in the grade of the ore mined, the yield during the half-year showed another decrease, the figure comparing with 315 tons, 349 tons, and 368 tons during the previous half-years. The drop in the price of tin has also had an adverse effect on the prosperity of the company, and the accounts show a loss of £1869 for the half-year. During the years 1911, 1912, and 1913, the dividends were at the rate of 13½%, 40%, and 16½%. Development is being extended on a larger scale, and favourable results have been obtained on the 780-ft., 1320-ft., 2010-ft., and 2250-ft. levels.

Wheal Kitty & Penhalls.—This company was formed by J. H. Collins in 1906 to acquire tin mines in the St. Agnes district of Cornwall, which had previously been worked on the cost-book system. During the years 1911 to 1913, the grade of the ore mined fell considerably, but the report now issued for the six months ended June 30 shows that more recently discoveries of richer ore have been made. The output for the period was 132½ tons of tin concentrate, extracted from 9645 tons of ore. During the corresponding period of 1913, the figures were 74½ tons and 6804 tons respectively. The yield per ton was 30·8 lb., as compared with 24·5 lb. Unfortunately the fall in the price of tin has nullified any advantage arising from this improvement in grade, for the average price obtained for the concentrate was only £97. 18s. per ton as compared with £128. 12s., and the value of the yield per ton only 26s. 10d. as compared with 28s. 1d. The total receipts were £13,041, and the net profit £213. The mining cost inclusive of every item was 26s. 7d. per ton, as compared with 27s. 3d. a year ago. The developments during the period have been encouraging, and large blocks of ore are ready for stop-

ing in both the Vottle and Sara's sections. Amos Treloar is the superintendent.

Weardale Lead.—This company was formed in 1883 to work a group of lead mines in Durham, not far from the county boundaries of Cumberland and Northumberland, and in the same mineral formation as the Nenthead and Alston mines. The galena occurs as a replacement in Carboniferous limestone. Henry Louis is technical advisor, and H. S. Willis is manager. The report for the year ended June 30 last shows that 4990 tons of ore and concentrate was smelted, and 3709 tons of lead produced. The figures for the year before were 3547 tons of lead extracted from 4841 tons smelted. The average price obtained per ton of lead was £18. 11s. 5d., as compared with £17. 18s. 8d., and the total receipts £68,895, as compared with £64,342. Additional income amounting to £6089 was received from the sale of fluor-spar. The profit was £20,330, of which £7200 was written off the property account, and £12,239 distributed as dividend, being at the rate of 12½%. The development during the year has given good results at all the mines. The Boltsburn continues to be the largest producer of galena, and the Stanhopeburn and Sedling of fluor-spar. The production of fluor-spar during the year was 12,952 tons.

Central Zinc.—This company was formed in 1906 as a subsidiary of the Sulphide Corporation for the purpose of erecting zinc-distilling works in England intended to treat zinc concentrate produced at the corporation's mine at Broken Hill. The works are at Seaton Carew on the Durham coast. An output was first made in 1909, and the plant has been gradually increased until 6 furnaces are now in operation. The construction of two others is in hand. The report for the year ended March 31 shows that three conditions were against the company: the increased cost of coal, the advance in freight rates from Australia, and the fall in the price of zinc. For this reason, in spite of an increased output, the profit was only £926, as compared with £9146 the year before. The amount of concentrate treated was 9870 tons, for a yield of 3461 tons of spelter, 25 tons of blue powder, and 52 tons of metallic lead. The argentiferous leady residue, amounting to 6704 tons, was mechanically concentrated to 3321 tons, and in that form was suitable for treatment in lead furnaces. J. C. Moulden is manager of the works. The capital of the company is £150,000, all subscribed in cash by shareholders in the Sulphide Corporation, and the corporation guarantees 5% interest on these shares in return for receiving one-third of the profits each year.

Mount Morgan Gold Mining.—This company was formed in 1886 to acquire a gold mine near Rockhampton, Queensland, and for some years a huge output was made from the oxidized ore by chlorination. Later, the silicious ore charged with copper pyrite was roasted and chlorinated. In 1905 the proportion of copper increased so as to justify the erection of smelters. The oxidized ore has been exhausted for two years. On the passage of control a year and a half ago by the sale of the Hall interests to W. K. D'Arcy and Lionel Robinson, Clark & Co., the chlorination of pyritic ore was abolished and the operations confined to smelting. At the same time, plans were made by the new manager, Benjamin Magnus, for the erection of a modern smelting plant. The report now issued covers the year ended May 31, and shows that the new smelter is practically complete. A concentrator having a capacity of 500 tons per day is in course of construction, and the tailing is to be treated by the Minerals Separation process. A great deal of mine development has

been done during the year, with the object of preparing the concentrating ore for stoping and rendering the workings safe. It has been unavoidable that a larger proportion than usual of low-grade ore has been sent to the smelter. During the year, 243,353 tons of ore was treated, together with 60,075 tons of pyritic fluxing ore from the Many Peaks mine. The yield of blister copper contained 8463 tons of copper and 102,848 oz. of gold. The actual amount of copper sold is not specified, but the receipts from the sale of blister copper are returned at £934,464. The refining is done by the Electrolytic Refining & Smelting Co. at Port Kembla. The profit for the year was £276,351, out of which £77,297 has been charged for maintenance and depreciation and £200,000 distributed as dividend, being at the rate of 20%. Owing to the fall in the price of copper and the larger proportion of low-grade ore smelted, the profit for the year was £120,000 less than that for the year before. The expenditure on the new equipment to date has been £266,624. The ore reserve at the end of May was estimated at 1,211,000 tons of high-grade ore and 1,914,000 tons of medium grade, in neither case the content being quoted. In addition there are large reserves of low-grade ore, the extent of which is not estimated. During the year an option was taken, but eventually abandoned, on the Laloki mine in Papua. Two other properties in that country are now being investigated. Colin Fraser is at present making a geological examination of the Mount Morgan mine and of other properties belonging to the company.

Mungana.—This company was formed in Melbourne in 1901 to acquire the Girofla and Lady Jane mines from the Chillagoe company, which still holds a large interest in the share capital. The ore consists of mixed argentiferous lead and copper sulphides, with some oxides and carbonates, occurring in bunches in limestone. The mines are in North Queensland, 150 miles inland by railway from the port of Cairns. In 1912, the company was reconstructed and additional working capital raised. There are 500,000 shares of 6s. each, of which 5s. was credited as paid and 1s. called up in cash. The report for the year ended March 31 last shows that the fire that broke out five years ago at the Lady Jane is still burning, and that the policy of quenching by withdrawing the pumps has not been successful, as the water-level has not risen above the 250-ft. level. At the Girofla, 16,356 tons of ore averaging 11% lead, 1.7% copper, and 6 oz. silver per ton was raised and shipped to the Chillagoe smelter. In February of this year, the smelter was closed pending the construction of a branch railway to the Mount Mulligan coalfield. During the period of enforced stoppage at the mine, the main shaft has been sunk from 710 ft. to 810 ft. E. J. J. Rodda reports that 64,275 tons may be reckoned as having been developed by this work. He also mentions that the orebody is of greater area and better grade on the 710-ft. level than on the level above. The accounts show an income of £23,071 from the sale of ore, and a net profit of £2401, which was carried forward.

Arizona Copper.—As we have recorded on several previous occasions, this company was formed in Edinburgh in 1882 to work the Longfellow and Metcalf groups of copper mines in the Clifton district, Arizona. Large profits have been made for many years from ores of comparatively low grade carrying little or no precious metal. In order to make it possible to treat the great reserves of ore of lower grade, it was decided in 1911 to rebuild the metallurgical plant and extend the concentrators. At the advice of L. D. Ricketts, rever-

beratory furnaces of the Cananea type were adopted. The old plant was closed on December 31 last. Unfortunately the construction of the new furnaces was faulty, and delay and expense have been caused. The interim report now issued, covering the half-year ended March 31, shows that the output was 8454 long tons of copper, and that the net profit was £120,230. In addition a profit was made of £36,313 from the railway, making the total disposable profit £156,544. Out of this, £18,822 was paid as debenture interest, £12,265 as preference dividend, and £75,994 as dividend on the ordinary shares, being at the rate of 20% for the half-year. The remainder was allocated to capital expenditure. The total outlay on new construction has been £612,032, out of which £400,000 was provided by the issue of debentures and the remainder out of revenue. The additions to the concentration plant are nearing completion. The trouble with the new furnaces has continued for a longer period than expected. Owing to the original faulty construction of the bottoms, the roofs were weakened, and extensive repairs became necessary at an earlier period than the normal. The intermittent running of the furnaces reacted on the roasters, and these had to be re-lined.

Otavi Mines & Railway.—This company was formed in Berlin in 1900 to acquire a copper-lead property at Tsumeb, in German Southwest Africa. A railway 350 miles long was built by the company to connect the property with the port of Swakopmund, and subsequently the line was sold to the German government. Most of the ore is shipped to Europe, and ore of lower grade is smelted on the spot for the production of copper-lead matte, also shipped. The ordinary share capital is 4,000,000 marks divided into 200,000 shares of 20 marks each, and there are 200,000 deferred shares. Dividends were first paid in 1908. The report for the year ended March 31 shows that in spite of the lower average price of copper the profits have increased owing to larger shipments and decrease in the cost of mining, smelting, and transport. The amount of ore raised was 70,100 tons, as compared with 54,100 tons the year before, and the ore shipped was 50,070 tons averaging 13% copper, 23% lead, and 7.7 oz. silver per ton. At the smelter 1179 tons of matte was produced containing 49% copper, and 22% lead, with 40 oz. silver per ton. The orebody has been proved on the 5th level, at 420 ft. depth, to be as extensive and high in metal as the level above. The main shaft has been sunk to 520 ft. and a 6th level begun. The dividends on the ordinary shares absorb 9 marks per share or 45%, and the deferred shares take 8% per share or 40%. The board of directors receive a bonus of 259,459 marks, equal to £12,973. At one of the mines 450 tons of vanadium ore was produced and shipped.

Forum River (Nigeria) Tin.—This company was formed in March 1912 to acquire alluvial-tin properties from the Northern Nigeria Trust. The properties are situated to the south of Naraguta and 15 miles east of Jos. Reports were made by Howard Johnson, and A. W. Hooke is manager. Up to the present time, operations have been confined to calabashing, but arrangements are in hand for the commencement of hydraulic mining. Two ditches have been cut, one of them 3½ miles long, and a concrete dam has been built. A pipe-line is in course of construction. The report for the year ended March 31 shows that 246 tons of tin concentrate was produced averaging over 73% metal. The account shows an income from the sale of an unspecified amount of concentrate of £19,669, and a net profit of £132. The chief cause of decrease in profits is the drop in the price of tin.

Consolidated Gold Fields of New Zealand.—This company was formed by the Exploration Company in 1896 to acquire from David Ziman properties in the Reefton district on the west side of the south island of New Zealand. In the same year the Progress mine was floated as a subsidiary, and in 1906 these two companies jointly floated the Blackwater. At the time of flotation Philip L. Foster was the consulting engineer. The control passed from the Exploration Company in 1903. The directorate now includes L.

better results. The company holds 169,943 shares in the Progress Mines of New Zealand and 92,024 shares in the Blackwater. The Progress company holds 86,295 shares in the Blackwater. All these shares are of £1 denomination. The ordinary capital of the Consolidated is £242,377, that of the Progress £275,000, with £36,810 debentures, and that of the Blackwater £249,992. The arrangement whereby the vendor's share was commuted was described in our issue of August a year ago.



Ehrlich and E. T. McCarthy. The company itself works the Wealth of Nations mine. The report for the year 1913 just published shows that 23,661 tons of ore was raised and treated for a yield of gold worth £38,737. The working profit was £6292, and £4648 was received as dividend paid by the Blackwater company. Out of the total profit £4883 was paid to David Ziman for the purpose of finally extinguishing his rights as original vendor. The remaining balance was carried forward. The development at the Wealth of Nations during the year has exposed a smaller amount of ore than was anticipated, owing to the gold content of the recently discovered West Reef not coming up to expectations. Since the close of the year under review the development has given rather

Progress Mines of New Zealand.—The report of this company for the year 1913 shows that 34,996 tons of ore was raised and treated for a return of gold worth £53,332. The net result was a loss of £2431, but as £4314 was received as dividend from the company's holding in Blackwater shares the year ended with a credit balance of £1883. As regards development, important results were obtained toward the close of the year in the ground to the south of the main fault and near the southern boundary of the property. Particulars of these developments have already been published, and the directors state that they consider that a noteworthy revival in the company's fortunes may be expected. General information as to this company is found in the preceding paragraph.

Blackwater Mines.—As mentioned in the paragraph relating to the Consolidated Gold Mines of New Zealand, this company was formed in 1906 to acquire a property near Reefton, New Zealand. The mine has during the last few years been the most promising of the group. Excellent dividends were paid in 1910 and 1911, but the general strike of mines afterward interfered with operations. The results for 1913 show a recovery, and it has been possible to distribute a small dividend at the rate of 5%. During the year, 45,052 tons of ore was raised and treated for a yield of 17,689 oz. by amalgamation, and 1699 oz. by cyaniding, worth together £82,224. In addition 462 tons of concentrate was obtained estimated to be worth £4841, but only a small portion was sold, for £224, bringing the total receipts for the year to £82,449. The net profit was £20,631, out of which £12,499 was distributed as dividend, being at the rate of 5%. Development to the extent of 3730 ft. was done during the year, an amount that may be considered satisfactory seeing that the labour-supply was limited. At some points the lode was found to be much broken, but on the whole the developments have been promising. The latest news is that the main shaft has been sunk to 1018 ft., at which point the lode was cut, averaging 36 dwt. over 3ft. During the half-year ended June 30, 24,697 tons was milled for a yield of £47,146. The ore reserve on December 31 was estimated at 104,727 tons averaging 9.9 dwt. per ton over a stopping width of 32 in. A. Winter Evans is general manager of the Consolidated Gold Fields of New Zealand group of mines.

Robinson Deep.—This company belongs to the Consolidated Gold Fields group, and owns a property in the central part of the Rand, in the midst of the mines belonging to the Central Mining group. The property constitutes a 'second deep,' being on the dip of the Robinson Central Deep (now absorbed in the Crown Mines) and the Ferreira Deep. Milling commenced in 1898 with 40 stamps and 260 were subsequently added. Later it was decided to gradually increase the number of tube-mills to 13, and to use only half of the stamps, the object being to treat larger quantities of lower-grade ore. The report for the year ended March 31 shows that an average of 138 stamps and 9 tubes were at work. The ore raised was 670,508 tons, and after the rejection of 51,168 tons of waste, 619,140 tons was sent to the mill. The yield by amalgamation was 136,828 oz. and by cyanide 65,944 oz., a total of 202,772 oz., worth £851,429, being an extraction of 6.55 dwt. or 27s. 6d. per ton. The working cost was £526,897, or 17s. per ton. As compared with the previous year, the yield per ton was 2s. less, and the cost per ton 9d. lower, while the total profit was reduced by £40,863. The shareholders received £275,000 in dividends, being at the rate of 27½%. In spite of the labour troubles neither mining nor development was checked appreciably. The ore reserve was estimated on March 31 at 1,533,000 tons averaging 5.9 dwt. per ton, and in addition 407,000 tons averaging 5.8 dwt. is described as partly developed. The ore of better quality is being rapidly exhausted. A large amount of sand-filling is being done, owing to the dangerous nature of the hanging wall at various places, and also with a view to reclaiming old pillars. Hammer-drills are now extensively employed, 60% of the ore raised during the year having been stoped by this means.

Alaska Treadwell.—The report of this company operating part of the wide low-grade orebody on Douglas island, Alaska, shows that the two mills containing altogether 540 stamps treated 886,057 tons of ore for a

yield by amalgamation of \$1,221,642 and by the cyaniding of sulphide concentrate of \$1,136,780, making a total of \$2,358,422 or \$2.66 per ton. The working cost was \$1,071,925, or \$1.21 per ton; \$400,000 was written off for depreciation, and \$1,000,000 was paid as dividend, being at the rate of 20%. The cyanide plant erected two years ago to treat the concentrates produced at the Treadwell, United, and Mexican, instead of shipping them to the Tacoma smelter, has proved a great success, as the cost has been only \$3.05 per ton of concentrate and the recovery 97.3%. As recorded last year, the deeper portions of the three mines are to be developed from the Central vertical shaft of the 700-ft. mine of the Alaska United, the shaft being sunk direct from the 1750-ft. level of the Treadwell to a level at 2100 ft. This shaft has now reached a depth of 2271 ft. a and cross-cut is being driven to the lode at 2100 ft. The ore reserve above the 1750 ft. level, including pillars, on December 31 was estimated at 6,098,308 tons averaging \$2.67 per ton. This shows a fall of 884,650 in tonnage and 5 cents in content as compared with the previous year. The number of men employed was 719 and their average wage \$3.51 per day. F. W. Bradley is president of the group of companies and Robert A. Kinzie superintendent. Since the start in 1885, the Treadwell has yielded \$33,964,624 from 13,867,789 tons of ore, and \$13,785,000 has been paid in dividends.

Alaska Mexican.—The report for the year 1913 shows that 227,112 tons of ore was raised, and gold worth \$489,697 extracted by amalgamation and by the cyaniding of concentrate, being a yield of \$2.15 per ton. The working cost was \$297,497 or \$1.31 per ton, and \$180,000 was distributed as dividend, being at the rate of 20%. Since the commencement of operations in 1894, 3,820,446 tons of ore has been treated, for a yield of \$10,438,713, and \$3,273,381 has been distributed as dividend. The developments in the lower levels during the year have given disappointing results, and the reserve has dropped from 575,398 tons averaging \$2.75 at the end of 1912 to 430,939 tons averaging \$2.53 at the end of 1913. No further development will be done on the present levels, and the mining of the continuation of the lode in depth will be done from the 2150-ft. level, as outlined in the paragraph devoted to the Alaska Treadwell.

Alaska United.—This company owns the 700-ft. mine between the Treadwell and Mexican properties and the Ready Bullion mine farther to the east of the Mexican. Operations were started in 1898. The report shows that at the 700-ft. mine 225,435 tons of ore was raised, and \$532,152 extracted by amalgamation and by the cyaniding of concentrate, being a yield of \$2.36 per ton milled. The working cost was \$318,707 or \$1.41 per ton. The ore reserve has been raised during the year from 1,154,273 tons to 1,281,475 tons, but the average content has fallen from \$2.63 to \$2.46. At the Ready Bullion mine, 222,992 tons was treated, for an extraction worth \$511,391 or \$2.29 per ton. The working cost was \$322,603 or \$1.44 per ton. The ore reserve on December 31 was 1,708,662 tons averaging \$2.91, as compared with 1,721,521 tons averaging \$2.82 the year before. The dividend paid by the company out of the profits of the two mines was \$414,460, being at the rate of 46%. The vertical sections and plans of the Treadwell, 700 ft., and Mexican mines show that the length of the orebody is rapidly diminishing. Apparently there is little to be expected in depth in the Treadwell and Mexican, and when the 2150-ft. level is reached the bulk of the ore will probably be in the 700-ft. mine.

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213.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor.

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❖ REVIEW OF MINING ❖

INTRODUCTORY. — Dealings in mining shares are insignificant, only small lots changing hands for cash. The Stock Exchange is to be re-opened on November 18, principally to deal with the account as left on July 28. However, a bar to effectual business is presented by the fixing of minimum prices, the Committee having done so for the obvious purpose of preventing unloading from abroad. The moratorium ended on October 4 as regards retail business, and it is to end on November 4 as regards bills of exchange, but the beneficial effects are not yet evident. The intermediary steps taken by the Government have anticipated the lifting of this financial embargo. The Courts of Emergency now established tend further to prevent a rigid enforcement of claims.

TRANSVAAL.—The rate of production improved in September, but, being a short month, the total yield of gold was slightly less than in August. The value £2,982,630 compares with £2,999,686 in the corresponding month of last year. As regards labour, a slight increase in the supply is recorded, making the total 169,619, as against 152,637 this time last year. Two large properties, the Modderfontein Deep and Government Gold Mining Areas, are approaching their period of productivity. Both should begin milling before the end of the year.

RHODESIA.—The output of gold in August was slightly less than that in July, but, at £316,972, it is the second best on record. The decrease is due to the smaller return from the Shamva, which yielded £31,283 in August

as against £38,455 in July. The Cam & Motor, Globe & Phoenix, and Eldorado made slight gains. The silver production of 11,786 ounces is worthy of record.

The Bell Reef Development company, which began milling in February, has increased production steadily, until in August 3684 tons was crushed for a yield of gold worth £6689. The full capacity of the mill is 4000 tons, a figure that is expected to be reached shortly. The ore reserve of 56,788 tons, averaging 12'4 dwt. per ton, represents a supply for 14 months. The estimated cost is 25s. per ton, but it has not been realized as yet. The company owes £50,000 to the Gold Fields Rhodesian Development Company, so that the shareholders cannot receive dividends for some time to come.

On October 9 it was announced by the Colonial Office that no modification of the administrative functions of the British South Africa Company is to be made now, but that a supplementary charter will be issued giving effect to the arrangement whereby the directors of the company have agreed to render possible the establishment of responsible government in Rhodesia, should the Legislative Council desire it, and should His Majesty's Government concur, at some date other than that which the charter permits. This is in accord with the sentiments of the people in Rhodesia, as indicated at the General Election in March, when the advocates of responsible government were defeated.

Mr. Drummond Chaplin has been appointed Administrator of Southern Rhodesia in suc-

cession to Sir William Milton, retired. The appointment has been well received in South Africa.

WEST AFRICA.—The gold output in August was worth £150,386, as against £151,923 in July, the slight difference being due to the shorter month. The crushing of ore from the Cinnamon Bippo at the Abosso mill has not yet fulfilled the estimate, the tonnage treated being slightly over 2000 tons as against the anticipated 6000. Hence the cost is 36s. as against an estimated 28s. per ton.

Shipments of tin from Northern Nigeria have been resumed since the beginning of September. The Rayfield did well in September, shipping 63 tons of concentrate, the total output for the month being 75 tons, which is the best this mine has done.

AUSTRALASIA.—According to well informed advices from Melbourne, it is thought that the war will stimulate gold mining, as is usual during periods of depression. As the mining of the base metals is dependent on the European markets, it is likely that during the early period of the war this industry will be disorganized. The Port Pirie and Cockle Creek lead smelters are working full time, but the export of lead and zinc concentrates is in abeyance, owing to the closing of the Belgian and German smelters. Contracts with these were suspended on August 3. At Broken Hill the following mines are working half-time: Proprietary, North, South, and Central. It appears that the Proprietary smelter at Port Pirie was not closed-down in August, but we understand that this was contemplated, owing to pessimistic metal-market reports, since corrected by the demand for lead from Russia, for example. The big copper mines of Australia are all deeply affected by the war, and the consequent collapse in the market for that metal. The Mount Morgan, Mount Lyell, and Wallaroo & Moonta are working on a reduced scale. The Hampden Cloncurry has shut-down, owing to suspension of its selling contracts.

Papua, or New Guinea, was shared by Dutch, German, and British colonies until recently, when the German part-ownership was eliminated. This is fortunate for the Broken Hill Block 10 company, which has taken an option on the Kulamadau mine on that island. The manager is now inspecting the property. The mine is said to have been operated on a small scale for many years as a low-grade gold affair, the last crushing of 1976 tons yielding gold worth £2450. The orebody is reported to be 1100 feet long, containing a considerable tonnage of 8 to 10 dwt. stuff, which on a larger scale of operations, can be exploited for a profit of about 12s. per ton. The option involves a cash payment of £6000 and a quarter share-interest in a company to be formed.

RUSSIA.—The Lena Goldfields has washed 555,591 cubic yards of gravel during the current year, up to the end of July, for a yield of £976,302. The average yield is 35s. per yard. During the season of 1913 the output was 456,218 yards, yielding £670,146, while in 1911 it was 504,172 yards, yielding £961,342, or an average of 38s. per yard. The labour troubles spoil the record of 1912 and 1913. The statistics for the current year compare well with those of 1911, a slightly larger production at a lower average yield being the chief feature. In the first three weeks of July, owing to mobilization, the company lost 1361 employees, but during the rest of the month a gain of 736 men is reported. During the last 10 days of July the grade of the gravel was raised to 51s. per yard for an output of 30,756 yards, improving the average for the year by 1s. per yard. This is in accord with the statement appearing in our last issue.

MEXICO.—A renewal of turmoil is announced. The long-expected quarrel between General Carranza and General Villa has come to the point of open rupture. On September 24 Villa announced his intention to march on Mexico City. He is supposed to have an

army of 30,000 loyal and well equipped troops. The states of Chihuahua, Sonora, Zacatecas, and a part of Coahuila are under his control. On September 26 it was reported that a Carranza force under General Gil had been defeated at Santa Barbara by troops commanded by the Governor of Sonora. The Provisional Government has decided to issue paper money to the amount of 130 million pesos. The withdrawal of the American troops at Vera Cruz was countermanded and two additional warships have been sent to Mexican waters. On September 27 General Funston reported that Zapata had protested against the evacuation of Vera Cruz by the American troops and the handing of the city to the Constitutionalists. On the same day Villa issued an assurance that he would not be a presidential candidate. Carranza followed suit. The name of Señor Francisco I. Calderon, a leader of the Liberal party, was mentioned as a compromise candidate. On October 1 Carranza went through the motion of presenting his resignation to the National Convention, and the performance was duly enacted according to programme, the resignation being "unanimously rejected" by the Convention. The official despatch states that "amid great enthusiasm the General has again resumed his post as Chief of the Executive." Meanwhile General Villa's remarks are not chronicled, nor those of General Zapata, nor those of other generals famous for their ability to devastate Mexico in the name of liberty.

Bullion to the value of 1,500,000 pesos is reported to have been seized on September 29 by the military authorities acting under General Carranza. Of this amount 72,000 pesos belonged to the El Oro Mining & Railway Company; the latest cable announces that this gold has been restored. Milling on a small scale was resumed by this company at the beginning of October. This was done undoubtedly under pressure from the Carranza government. On September 30 it was re-

ported semi-officially at Washington that a decree had been issued at Mexico City annulling all mine titles granted during the Huerta administration.

CANADA.—We learn that Mr. Morton Webber advised the Nipissing company not to acquire the McIntyre mine at Porcupine, owing to the high price, amounting to \$1,500,000, including bonds and debts. The real merit of the property was eclipsed by the financial factor. Our Toronto correspondent sends an interesting letter on conditions at Porcupine and Cobalt.

UNITED STATES.—The mill of the Plymouth Consolidated started at the end of July, dropping 20 out of the 30 stamps. During August 8199 tons was crushed, yielding \$31,789, or an average of \$3'87 per ton. The September crushing is better, averaging \$4'56. The cost is estimated at \$3 per ton. As yet the ore supply is coming from the dumps and low-grade ore broken in the old part of the mine above the 1600-ft. level. On the 2000 the plat is now finished, so that ore can be stoped along this level. Mr. W. J. Loring has cabled from California that the prospects are excellent. A working option on the Montezuma, also in the Plymouth district, was obtained just before the war and some preliminary work was done, but operations are now suspended.

The capsizing of the Pato dredge, of the Oroville Dredging Co., on September 12, has delayed operations for one month. The dredge has been re-floated successfully since the accident. An explanation of the circumstances would be interesting, as the dredge is a new machine and should have behaved better. Since the beginning of July the average yield of gold has been equal to 61 cents per cubic yard from 302,000 yards.

At the end of June, 1913, the old Camp Bird mine was estimated to have remaining 31,000 tons of 'profit-value' of £66,800; since then it has yielded £106,084 in profit.

The Tomboy increased its dividend this year to 4s., the profit for the 12 months to June 30 being £81,000. An increase of 26,000 in the ore reserve brings the total to 452,000 tons or enough to supply the mill for 3 years.

INDIA.—Further exploration is now being conducted on the upper levels in the Mysore mine. On the 1300-ft. level in the Ribblesdale section, a drift in a northerly direction through virgin ground was in ore for 300 ft., from 3 to 5 ft. wide, and assaying $1\frac{1}{4}$ to $2\frac{1}{4}$ ounces per ton. A winze is following this ore-shoot and is in high-grade ore. In the Anantapur group, a pleasant impression has been made by the declaration of a dividend for the year ended June 30, at the rate of 4s. 6d. on the preference shares and 6d. on the ordinary shares. The preference shares are entitled to 20% and subsequently rank equally with the ordinary. A year ago the distribution was 10% on the preference.

Some absurd statements regarding native labour appears in recent issues of our New York contemporary. The idea of employing natives "to save them from starving," and so forth, is rubbish. Some youngster is getting into print prematurely.

SPAIN.—The Rio Tinto company has passed its half-yearly interim dividend. Labour trouble in January and April caused interruption to operations, but not to an alarming extent. The cause of the suspension of dividend is the great reduction of output caused by the war, for the company had a large market in Germany for copper and copper ore, and for pyrite sold to chemical manufacturers for its sulphur content. At the Cordoba copper mine the smelter was closed on August 11, but was re-started on a limited scale toward the end of September. Development was not interrupted during this time.

CORNWALL.—Ticketings were resumed at Redruth on September 21, and another was held on October 5. The average prices obtained for black tin on these two dates were

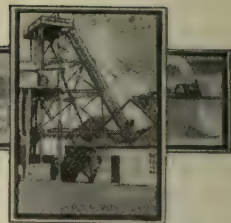
£72 and £73 respectively, about £10 lower than the prices ruling during June and July. Dolcoath did not offer any concentrate for sale on the first occasion, and one or two of the mines did not accept the bids made by the smelters.

Cornwall is doing its full share in providing soldiers for our defence. We are informed that more than 100 men in the employ of Holman Bros. have responded to Lord Kitchener's call. Many miners from Dolcoath, Grenville, and Carn Brea & Tincroft have volunteered for service.

VARIOUS.—Regarding the alleged platinum discoveries in Westphalia, we are informed authoritatively that platinum is indeed present in the mica-schist, but in patches so small that no single ton of rock can be mined profitably.

The Mawchi Tin & Wolfram Mines has had bad luck; the floods in Burma damaged the dam and flume, and so delayed milling; then came the war, which stopped the sale of its tin and wolfram concentrates. Meanwhile the mill has not done well, the presence of scheelite with the cassiterite having been overlooked. Not being able to borrow further capital, the company is to be reconstructed. As the Southern Shan States Syndicate holds 140,942 Mawchi shares, that concern also will have to be re-organized.

METALS.—The Metal Exchange is still officially closed, but a fair amount of business has been done. Copper has been sold at from £55 to £58 per ton, tin at £135, zinc at £25, and lead at £18 to £19. In the iron and steel market, prices have remained remarkably steady at the same level as before the war. Nickel is quoted at £195 per ton, and aluminium at £86, cobalt at 7s. 9d. per pound, and tungsten at 5s. 6d. per pound. Silver has kept steady at about 24d. per ounce, the only regular buyer being the British government for minting purposes. Antimony has risen to over £40 per ton.



EDITORIAL



WE are fighting as a united Empire in a cause worthy of the highest traditions of our race.

NO meeting of the Institution will be held in October, and the question of the next meeting has been deferred, pending further military and financial developments.

OFFERS of German debtors to pay in war-loan scrip is not an expression of Teutonic humour, but another evidence of the intention to evade foreign obligations. In the literature of Pan-Germanism it is announced with the utmost effrontery that such conduct is part of the programme; otherwise we would not be warranted in anticipating fraudulent action.

IN a proclamation dated September 21 the British Government announced that iron ore, unwrought copper, lead in pig, sheet, and pipe, and ferro-chrome were to be treated as contraband of war. As regards the first-named, the aim was to prevent the importation into Germany of Swedish and Spanish ore. The ore from Sweden is delivered mainly in Swedish ships through the port of Rotterdam. Owing to a protest from Sweden, to the effect that one of their basic industries would be ruined, the British Government has, for the time, deferred action in this matter. The embargo against copper has also been removed, owing to representations from the United States government, shipments being permitted to Rotterdam of such copper as is required for Dutch consumption. What is to prevent

the ultimate delivery to Germany of shipments through Rotterdam is not quite clear.

MEMBERS of the R.S.M. Association are reminded that the dues are half a guinea per annum; about 70 members are in arrear, and are requested to remit to the Secretary. The funds of the Association are likely to prove of the greatest use in helping R.S.M. men doing their duty at the front.

EVERY Englishman should obtain a copy of the diplomatic correspondence preceding the war. The Government has issued it in a pamphlet containing also an introduction, written at the Foreign Office, and a verbatim report of the speeches made by Sir Edward Grey and Mr. Asquith in the early days of August. This pamphlet includes the supplementary despatches of our ambassadors at Berlin and Vienna. Nothing more interesting or more worthy of preservation has been published for many a year—yet the price is only one penny. The postage is 1½d.; for 2½d. we shall be glad to send a copy to any of our readers.

AMONG the contributors to the relief funds, we note that the staff of the Rio Tinto sent £321, the Waihi £500, the Cape Copper £210, the St. John del Rey £157.17s., Mr. George Chalmers £200, and A. Goerz & Co. £105, while to the Red Cross fund the Mysore contributed £525, the Champion Reef £262. 10s., and the Exploration Company £100. We take pleasure in reproducing the telegram sent from Nigeria by the staff of the

Rayfield tin mine, asking the London office of the company to pay £100 to the Prince of Wales' Relief Fund and deduct the amount from their salaries.

GALICIA is likely to play an important part in the war, not only as the scene of the Austrian debacle but as the source of petrol for German use. Of the world's supply of crude petroleum in 1913, Galicia yielded 1,090,000 metric tons, and Rumania 1,885,000

being taken, by the Russian government, to make use of this asset without delay.

AMONG the tragedies incidental to the war we record the following: a German living in England, but not naturalized, returned to Germany to fight for his native country; at the same time his son, an officer in the British army, went to fight on the opposite side. Two brothers were in partnership; one was not naturalized; the partnership was

Rayfield tin mine, asking the London office of the company to pay £100 to the Prince of Wales' Relief Fund and deduct the amount from their salaries.

TELEGRAM

ISSUED FROM ELECTRA HOUSE, FINSBURY PAVEMENT.

REPLIES SHOULD BE ORDERED *Via Eastern*

Double words should be OFFICIALLY repeated. See Rate Book.

No inquiry respecting this Telegram can be attended to, without production of the Copy.

14/SEP/14

HA HA HA 228 NARAGUTA 24 14 LI PASLAG =

WETHERED 54 NEW BROAD STREET LONDON =

= PLEASE PAY PRINCE WALES RELIEF ONEHUNDRED POUNDS BEHALF

RAYFIELD STAFF DEDUCT FROM SALARIES LIST FORWARDED = JOHN ILES

TELEGRAM SENT BY THE MANAGER OF THE RAYFIELD MINE, IN NIGERIA, TO THE COMPANY'S LONDON OFFICE.

tons, these being the only oil-producing regions of any importance in Europe, outside Russia. Germany produced 140,000 and Italy 10,000 tons, both negligible factors. Rumania is a neutral and has placed an embargo on the export of oil. Galicia being a part of the Austro-Hungarian empire has been the chief source of supply for the enemy. Of the petroleum production of Galicia, 90% comes from the Boryslaw - Tustanowice field, which is about 70 miles south of Lemberg. The oil region as a whole extends along the northern slope of the Carpathians, and is now in the possession of the Russian armies. Steps are

therefore automatically dissolved by law on the declaration of war, and the business destroyed.

ENGLISH coal mines are hard hit as regards their supplies of timber, which used to come from Russian ports on the Baltic sea. Germany declared mine-timber contraband of war, but in any case the ships carrying it, being British, would be open to the attack of the enemy. Russia provides over one half of the timber used in our mines, other countries of origin being Sweden and Norway, East Prussia, France, Portugal, and

Spain. A commission has been appointed by the Board of Trade to visit Canada with a view to securing an alternative supply. Steel supports have not been used to any great extent in this country owing partly to the cost, and partly to the absence of warning of their failure. In some districts reinforced concrete has been employed, following the lines adopted in French and Westfalian mines, and probably the use of this substitute will be extended.

ISSUANCE of greenbacks, or paper currency, instead of gold pieces, by the banks of San Francisco is a sign of the times, as will be appreciated by mining engineers who have cashed drafts on their passage through the city of the Golden Gate.

AMONG other reasons for hating the Prussian government is its deliberate effort not only to prostitute its own press, but that of other countries, including our own. Meanwhile the Wolff Agency affords a sufficiently humorous example of this latest application of German culture in its now traditional militant aspect.

A CURIOUS feature of the spelter market has come to light. The cartel, or syndicate regulating zinc production in Europe, has been able to establish two prices: the one in London upon which all ore purchases are settled, and the other on the Continent, upon which the cartel will sell spelter in quantities sufficient for the large consumers. The difference between these two prices has ranged from 7s. 6d. to 25s. per ton. This little joker seems to be directed chiefly against the Broken Hill companies, all of which have relied upon London as a free market, as was the case at the time when the contracts were signed. The companies depended upon London continuing to be such a free market, but now they find themselves in the position of losing a difference that, applied on their total

output, involves big money. This discrepancy—to put it mildly—certainly calls for some explanation from the Germanic houses that have obtained complete control of our metal markets. Obviously, the Metal Exchange should exclude from membership any metal broker having an alliance either with a smelting or mining business.

WAR is hard on journalism, because it means a sudden transfer of public attention to new channels of thought. Among the first victims of the Great Unpleasantness is the *Rhodesian Mining Review*, which, in its issue of August 26, announces the cessation of publication. Rhodesian mining affairs have not been as interesting as heretofore and news is hard to collect at Bulawayo, but the *Review* was a clean and capable commentator. We are sorry to see its career brought to an untimely end, but as its editor, Mr. H. S. Hodges, will continue his connection with other journals published in Rhodesia, the salutary influence will continue.

IN consequence of changed conditions, the enrolment of volunteers by the Institution was discontinued. At the time this patriotic effort was first made, it was deemed necessary to prepare for invasion, and to this end a general rally was sounded. Since then that contingency has become extremely remote, but facilities have been afforded for the distribution of volunteers among various regiments in the army. We may add that the other engineering societies went through a similar experience and have likewise been instrumental in hastening the response to Lord Kitchener's call for additional troops. On another page we give the roll of honour or list of those that are serving with the colours. We include not only members of the Institution, but their sons, and others connected with mining. Many of these hold commissions, but we do not care to differentiate, for the

man in the ranks offers a service not less honourable than that of the officer. Corrections and additions to the list will be welcomed.

A good deal of unnecessary trouble has been made by some of our London clubs by defining uncongeniality during war in impossible terms. One club issued a notice requesting all those of German and Austrian origin to keep away; another posted a notice in its club-rooms placing an embargo on those of German and Austrian nationality. In both cases it might have been better to express the exception in terms of sympathy with the enemy in time of war, irrespective of nationality, naturalization, or origin. The use of the last as a means of distinction is humorous when we remember the serene highnesses and other illustrious Englishmen that are of German stock. The fact is that the effort to delimit people by race is one that is readily rendered ridiculous by excess of zeal. England has ever been a haven of refuge for the independent and recalcitrant of other countries, and some of our best stock has been enriched thereby. The person likely to spoil our luncheon at this time is not the man of any specified origin but he who expresses his sympathy with the ideas and the persons that we are fighting.

OUR sympathy goes to Mr. E. F. Roeber, Ph.D., editor of *Metallurgical and Chemical Engineering*. We met him last at the American Institute dinner and meeting called to do honour to Dr. Friedrich Kolbeck, of the Freiberg Mining Academy, at New York last May. The affair had a pronounced German flavour, from the chairman's German accent to Dr. Kolbeck's speech in German, but that was no blemish then; we were glad to be present and to participate in paying a deserved compliment to the worthy representative of the great German mining school. In the September issue of his periodical, Dr.

Roeber concludes that "all Europeans have suddenly gone crazy." He speaks of "crowds and nations that act under the blind forces of Nature." The war, to our genial acquaintance at New York, is a "gigantic human reaction" in which "the most celebrated individualities do not seem to have much more freedom of will than the 'free' ions of the dissociation theory." This may be a delightful chemical simile, but to us it is flavoured too much with that pestilent Prussian notion that war is a 'biological necessity,' that the breaking of a treaty is condoned by necessity, that atrocities are another part of warlike necessity, and so forth, to the end of the ensanguined chapter of mad militarism. No, Dr. Roeber, this will not do. The prevalence of such ideas among educated Germans, the acquiescence of university professors in the sinister writings of the Treitschke and Nietzsche school, and the lack of protest against the vapourings of the Potsdam War-Lord are among the causes of this great catastrophe. To us the preaching of organized murder in terms of culture is an abominable impertinence. Nay more, the violation of women, the hacking of young mothers' breasts, the murder of little children, the burning of helpless captives, the shooting of inoffensive peasants in the field may be acts of individual savagery for which the General Staff and the Kaiser are not responsible, but the sacking of Louvain and the destruction of Rheims cathedral, together with several other atrocities on a large scale, are the acts of high authority, for which no excuse has been, or can be, offered. In the face of such wanton barbarism, the chemical simile of 'necessity' is an insult to human intelligence.

TUNGSTEN is used largely in the manufacture of high-speed tool-steel, the physical characteristics of which are such as to allow the tool to work while red hot. This steel contains about 4 or 5 per cent of tungs-

ten together with smaller amounts of chromium and molybdenum. It was invented by Messrs. Taylor and White, of the Bethlehem Steel Company, Pennsylvania, and was first brought to the notice of the metallurgical world at the Paris Exhibition of 1900. Other tool-manufacturers nowadays produce a steel of similar characteristics, notably Thomas Firth & Sons, of Sheffield. As we have mentioned in recent issues, no tungsten or ferro-tungsten is produced in this country, and steel-makers have relied on Germany for their requirements. At the Mawchi meeting, Mr. O. J. Steinhart stated that arrangements had been made for the erection of a plant to extract tungsten from wolframite, separated from the ore mined by the Mawchi Tin & Wolfram Mines Company in the Southern Shan States. Until 1906 a factory existed in London for the manufacture of tungsten metal, but it suffered from lack of the necessary supply of ore and for other reasons.

CASUALTIES due to warfare are a prominent subject at this time, so that the passing of worthy civilians receives scanty notice. During the past month several notable men, distinguished in the mining industry, have crossed the last range. Jacob Langeloth, who died on August 14, at the age of 62, was the president of the American Metal Company, New York. Born a German, he became an American and was prominently connected with large metal and mining affairs. Apart from business, in which he was recognized as an able and supremely honourable man, he had a kindly and generous personality. He was a friend of Richard P. Rothwell and of another of the editors of the *Engineering and Mining Journal*. James B. Haggin, who died on September 12, was one of the veterans of the mining business, living to the great age of 92. Born in Kentucky, he was of Turkish blood on his mother's side. Hence his second name, Ben Ali. As

a partner of Lloyd Tevis, he took a prominent part in the mining development of the Rocky Mountain region, becoming identified with three famous mines, the Ontario, Homestake, and Anaconda. Subsequently George Hearst, the father of the gentleman now identified with yellow journalism, became his associate. In later years Haggin took hold of the Cerro de Pasco, in Peru, and acquired an interest in the Oriental Consolidated, in Chosen. Albert Grothe, who died on August 14 at Mexico City, was 70 years of age, and of late was largely identified with mining at Pachuca. His firm, Grothe & Carter, is responsible for the development of the Brown agitator or Pachuca vat. At an earlier period he was manager for the Tharsis Sulphur & Copper Co. in Spain. Henry Bratnober, whose death is reported from California, was another link with the vivid past. A big man, physically and in spirit, he was one of the most intrepid of those who sought for mines as a basis for large-scale industry. At one time, in association with Alfred Wartenweiler, he was the means of bringing sundry properties to London. During the rush to the Klondike his fine physique helped him in a great journey of exploration. He had the quality so rare now: an instinct for appraising mines, without the customary detailed sampling and examination. Thus in these four men we have represented the instinct, education, initiative, courage, and sagacity required in a great industry.

LETTERS received from friends in America prove that we have their entire sympathy. All the maladroit efforts of the German ambassador at Washington and the German press in the United States have failed to obscure the true cause of the war and the real issues at stake. The *New York Times* re-printed the British White Paper and the German Official Explanation in cheap pamphlet form so that the Americans

are not to be fooled by mis-statements whether from London or Berlin. The clumsy efforts to obscure facts have only tended further to alienate American sympathy from German aggression. The passage of the Home Rule act has placated Irish-American sentiment, and the Belgian atrocities have aroused keen indignation from New York to San Francisco. The violation of the treaty that guaranteed Belgian neutrality is properly condemned by a people that showed a keen sense of honour in the matter of the Hay-Paunceforte treaty. The swaggering militarism of the Zabern type does not impress a powerful democracy, for the American citizen, as Mr. Roosevelt has said, is fully able to recognize "the danger of a transatlantic application of all that Bernhardism implies." We are glad that it is so. Not to have American goodwill would have been a moral loss that is unthinkable; to have it is worth more than an army corps.

South-West Africa.

Among the military adventures incidental to the war, we may mention the attack on Raman's drift, a ford on the Orange river, which is the boundary between German South-West Africa and Little Namaqua Land, the latter being included formerly in Cape Colony and now in the Union of South Africa. Little Namaqua Land is interesting on account of the mining operations of the Cape Copper and Namaqua Copper companies at Ookiep and Concordia, respectively, eight miles apart. Ookiep is three miles north of Springbok, the capital, where a force of Cape Mounted Police is stationed. The Cape Copper Company's railway runs from Ookiep to Port Nolloth; and Steinkop, a station on this line, is the nearest point to Raman's drift on the Orange river. At that point two of the Cape Mounted Police and four German soldiers have long stood on guard, on opposite sides of the river. As this was the only ford across the lower Orange river, it was feared

that a German raid might be made on the mining communities at Ookiep and Concordia. However, this danger was averted by the prompt capture of the ford. The Union Government sent an expedition, which, by two forced night marches, surprised the German post and now controls the main southern approach to this German colony. A good deal of money has been spent on German South-West Africa, and it is one of the most prized of the German overseas possessions. The chief mineral resources of the region are diamonds and copper-lead ore. The diamonds are found in the sand-dunes on the shore, north and south of Lüderitzbucht, the German name for Angra Pequena, so named by Bartolomeo Diaz, the Portuguese navigator, who on this spot made the first landing of Europeans, or "christian men," as he phrased it, south of the tropic of Capricorn. The copper-lead ore is mined at Tsumeb, which is connected by railway to Swakopmund, the port built by German capital to supersede Walfish Bay, which was retained by the British when Damara Land was ceded to the Germans in 1883. Exports from South-West Africa increased from £556,770 in 1903 to £2,830,000 in 1909, but the colony is not yet economically independent, receiving a grant from the German exchequer.

When the treaty of Vereeniging was signed, a number of irreconcilable Boers crossed the Orange river into South-West Africa and were eagerly welcomed by the Germans, who gave them farm-lands on which they settled. During the last five years numerous complaints have been made against the Germans by these Boer settlers. The martial law, under which this colony was governed, was most distasteful to the Dutch and alienated their loyalty to the administration. Undoubtedly, the Germans expected their own Dutch settlers to aid them in the war with Great Britain, and it is also certain that they expected the Dutch in South Africa generally to revolt against British

control. That was why they made demonstrations at a number of posts along the boundary. Evidently their political insight was no better than that of the chancellerie at Berlin. The Dutch have rallied to the side of a liberal government and a live-and-let-live policy. But it must be remembered that this German colony has a large force at its disposal—possibly 10,000 troops—so that a respectable fight may be anticipated. However, they will be met by men who know every inch of the country, namely, the Boer frontiersmen, supported by the soldiers of the Union Army. What part the Herreros may play is not known; these natives have been shamefully treated by the Germans, but it is hoped that they will remain spectators of the conflict. In any event, some picturesque incidents are assured.

Pan-Germanism.

Most of us have only recently awakened to the magnitude and intensity of German ambition, as preached from Treitschke to Woltmann, as exploited by Von Bernhardi, Von Tirpitz, and Frobenius. We had read the thrasonic orations of Queen Victoria's grandson and dismissed them as the vapourings of a queer genius. We had seen excerpts from the writings of German professors, proving that their people were the only real thing in creation, and we had smiled at them as the frothings of a swelled head. In short, we thought our neighbour across the street was a man educated beyond his brains and too full of the heady wine of ill regulated ambition, but we never supposed that that neighbour was working with might and main to break into our house, kill our family, and possess himself of our premises. Since the beginning of August most of us previously too busy to read or too disdainful to study the literature of Pan-Germanism, the *Deutschland über Alles* theory, have turned to the evidence in the case, to find with mingled surprise and

dismay that for thirty years there has been cultivated in Germany the idea that the British Empire is decadent, that the day of reckoning is at hand, and that the natural successor to our wide inheritance is the German. And the self-appointed task of disposing of us is announced with a mixture of scholarly erudition and blatant arrogance that would call for ridicule if the matter were not, now, so serious. Every year 700 books dealing with war as a science are published in Germany as against 20 in England, and while the 20 are read by a small group of specialists, the 700 are eagerly studied by all sorts and conditions of men. Their main preoccupation is with the idea of war. It has become a vast wave of national thought. They have eagerly toasted *Der Tag*, when these dreams were to come true. From the Kaiser down they have been persuaded, by the Prussian school of historians, that most of the great men of the past, from Jesus to Dante, were of German blood. The blasphemous conceit has grown to a fixed belief that they only have greatness of soul and to the exposition of a so-called divine idea of Prussian over-lordship or world-dominion. Chauvinism in Germany has become, not a mere obsession, but a dogma in scientific dress. They forget that the German people is of mixed race and dub themselves the only ethnologic unit; they think the Prussian idea so potent as to be able to assimilate Turkey, Asia Minor, Persia, and a few other indigestible fragments of the map. And whenever the idea verges on the grotesque, there is the Kaiser, Wilhelm of Hohenzollern, to fan the flame of ambition, to tell them that they are the elect of God and he himself a partner with the Almighty. Even today, with the thunderous testimony of battle, it is hard to take this megalomania seriously. But we must. It is a fact. A handful of French writers, led by Rousseau, sowed the seed of the French revolution. Ideas are dynamic. When they possess a

whole nation, it is useless to ask whether they are right or wrong, it remains only to recognize that they are the dynamite of international politics. The dynamite exploded in the first days of August.

Pan-Germanism looks not only to the aggrandisement of dominion by military and naval aggression. It aims to gain industrial advantage by fraud. The argument is that while Germany's factories, mines, and farms are operated largely by aid of money borrowed from other countries, she owns them in reality, and, if her obligations on account of them were repudiated, she would still retain them while having caused great loss to the enemy-alien. This is a cultured method of supplementing naval and military attack. As soon as war begins, Germany pays nothing on her loans. If she is defeated, she will be compelled to pay according to contract, and no more; if she wins, she need pay neither principal nor capital. In this sort of game Germany claims the advantage, as she is a borrower country, while France and England are lenders. Contracts are only paper, the tangible thing is the property itself. Force can disregard scraps of paper in war and industry alike. The moral sense of obligation, says the Pan-German, has no validity in international agreements.

The central idea of Pan-Germanism is Prussian control of the Germanic confederation, German over-lordship in Europe, and Pan-German hegemony of this planet. The war with France and then with England, together with a casual acquisition of Belgium, Holland, Switzerland, and other inconsiderable trifles, is to be the prelude to "a determinedly aggressive scheme for the actual forcible conquest of the world." These are the words of Mr. Roland G. Usher, an American professor of history who has studied Pan-Germanism as a biologist studies the development of an *amœba*. For the space of a generation the inspiration of an entire school

of historic thought in Germany has been "the fate-appointed world-task of Germany" to impose her culture upon creation "under the sacred dynasty of the Hohenzollern." So says the late J. A. Cramb, a London professor of history, who has studied this phase of German thought sympathetically. And through all these nightmare imaginings runs the blatant idea that German culture is necessary for the world's well-being. The aim of these self-appointed apostles of a new dispensation is not only "to found a world empire but to create a world religion." Corsica has conquered Galilee. Blessed are the war-makers, for they shall be called the children of Odin, who is greater than Jehovah. That is the governing thought of the German creed. We have seen it translated into action at Louvain and Rheims.

Another part of the Pan-Germanic idea is that the British empire is only a trading monopoly, a weak chain of forts, and a monumental sham. England's naval power is the result of accident, not genius, such as that which created the German navy. The vitality of the British has been sapped by years of peace; they are no longer virile and warlike; they are too selfish and too cowardly to fight; like Carthage, the British empire has ripened to decay. The colonies will not fight for the maintenance of an empire the existence of which is of no benefit to them; the overseas dominions have nothing to gain by perpetuating their ties with a moribund kingdom; the diverse peoples under the British flag have little in common and have much to gain by coming under German control. Moreover, democratic government is less efficient than a centralized monarchy; England has lost immensely in offensive strength by having to defer to her people in matters of supreme importance; prompt utilization of all her resources is impossible. So say the professors at Charlottenburg and the junkers at Potsdam.

We have stated the case at some length,

because a proper understanding of the intellectual idea behind Prussian militarism and German megalomania is essential to every intelligent Englishman—and American—today. Some excuse may be offered for previous ignorance on the subject, but from this time henceforth such ignorance will be suicidal. It is late in the day to begin to understand our predatory neighbour, but we trust under Heaven that it is not too late. The morbid conceit of it all would be repellant even to a detached onlooker. To us, its intended victims, the systematic malignity of the propaganda is hateful indeed. The greatness of the Pan-Germanic imagination is stultified by its utter lack of humour. Treitschke, it is said, was never known to laugh. Nietzsche died in a madhouse. These two great apostles were both of Slavonic origin. Most of these German professors have an unhealthy lack of the Attic salt. The Kaiser also is lamentably deficient in that respect, otherwise his calm annexation of the Almighty would be suppressed by its blasphemous absurdity. He laughs best who laughs last. In other words, ridiculous as are the blunders of these mad mullahs of Europe and absurd as are the pretensions of these dancing dervishes, we must recognize that an idea backed by millions of armed men has a tragic dignity that nothing can gainsay except millions equally determined to prove that idea to be mistaken. The Prussian has said that we are decadent, that our empire is a sham, that our people are supine, that our dominions are disloyal, that we are unfit to rule and unable to fight—Well, brothers of the bulldog breed, it remains only to prove that all these suppositions are damnably untrue.

Naturalization.

The unreality of this legal procedure is being brought home to us at this time. Numerous Germans and Austrians resident but not naturalized in England at the outbreak of

war, have returned to their native countries to take their place in the line of battle. When the war is over, if they return, we shall be willing to shake hands with them, as brave men true to their convictions. On the other hand, there are many aliens naturalized here that have left our shores to perform military service for the enemy. Those ought not to be allowed to return, and if they return they should be shot as traitors. They divested themselves of their alien nationality and took the oath as British citizens; by going back and fighting for the enemy, they have proved themselves doubly renegades, first to the country of their nativity and then to the country of their adoption. They have done "the double cross," as the Americans say. For such we have no use whatever. The least they should do, even if, after naturalization, they felt the call of the blood, was either to honour their new allegiance to the country of their adoption by remaining inactive, or, if old ties proved compelling, to recognize their breach of faith and abstain from trespassing upon the hospitality of Great Britain a second time. Surely that is a fair view of the matter. We have no liking for the mean Teutophobia that takes advantage of the brutalities of war to injure innocent individuals, but it is proper that the obligations of naturalization should be set against its legal privileges. That does not involve unreasoning or ignorant vendettas against everybody with a German name. Sundry serene and illustrious personages have names of Germanic origin, but they have proved long ago, and they are proving now, that they are as good Englishmen as any of us. It is a mere provincialism to assume that every person with a Germanic name is German. Many Russians bear such names, and did originate from German ancestors. Take General Rennenkampf, the brilliant commander in East Prussia, for example. A recent episode gives point to this suggestion. We note that a company called the 'Carl

Hentschel, Ltd.', held a meeting for the purpose of changing its name to 'Knight's Manufacturing Co., Ltd.' It happens that Mr. Carl Hentschel was born in England and his father was a Russian. What a mare's nest it is! The fact is that our little island has been a haven of refuge to the independent spirits of every European country in turn, from Huguenots to Jews, and we have obtained thereby a valuable ingredient to the making of a nation. Let us be reasonable in our attitude during these difficult times and take care that the feeling of legitimate hatred of the Prussian enemy is not stultified by unreasoning prejudice or petty spite toward worthy people whose names do not happen to be Smith or Brown.

De-Tinning.

Among the humours of the war we may mention the fact that the Admiralty was urged to seize the Swansea Vale zinc smelter, owned by Aron Hirsch und Sohn of Halberstadt, Germany, as being the enterprise of an enemy-alien. The Admiralty declined to do so. We do not know the official reasons, but we may suggest two: (1) the fact that the Swansea Vale Spelter Company is registered in England and is therefore, as it were, naturalized in a business sense, and (2) the fact that the smelter is producing zinc, and thus is fulfilling the only function of immediate interest to the Admiralty. Of course, none of the zinc can be exported now, so the metal is just as useful as if it were produced by a purely British firm. Another similar incident concerns the London Electron Works Company's de-tinning plant at Limehouse. This enterprise also is registered at Somerset House, but for three or four years has been under the control of the Th. Goldschmidt Actien Gesellschaft at Essen. Its function is to recover tin from old cans. A rumour was circulated that the plant was closed on the outbreak of war, and that the 'German workmen had gone to the

war. On inquiry we find that the facts have been distorted. The London Electron company was started a dozen years ago to work Mr. E. M. Kardos's process whereby tin-cans collected by the municipal dustmen or accumulated by the wholesale confectioners and sweetmeat manufacturers were submitted, first, to cleansing operations for the removal of the clinging animal and vegetal matter, second, to a baling process whereby they were compressed into briquettes, third, to the action of heat to remove solder, paper, varnish, paint, or rubber, and, lastly, to electrolysis in a caustic soda solution, whereby the tin was precipitated in pulverulent form. The plant occupies a large area adjoining the Limehouse basin where the Regent's canal connects with the Thames. As we have already mentioned, the Goldschmidt company secured control, and for the last three years no stripping has been done here, the briquettes having been sent direct to Essen, where the tin was recovered by the dry chlorine process, and the remaining iron sold to the steel-makers. On the outbreak of war the business came to a standstill because the briquettes, of course, could not be shipped to Germany, and for two or three weeks the plant was idle while those in authority sought for an alternative method of conducting the business. It was decided to modify the heating furnace in such a way that most of the tin would be melted after the removal of the solder, the metal thus obtained being delivered to English tin-smelting firms. The amount of tin remaining on the briquettes is comparatively small and we are informed that Scottish steel-makers do not express any objection to its presence. So the business of the firm is continued, though naturally only in makeshift manner. No members of the staff returned to Germany, for they were all British, and Mr. Kardos himself remains at his post, accepting with equanimity and even cheerfulness the unfortunate position of an enemy-alien.

As regards the technology of de-tinning, the recovery of tin from scrap produced during the construction of cans and other ware from tin-plates has been conducted for many years in England, on the Continent, and in America. This scrap was produced in steady quantities at known centres, so that freight could be arranged and de-tinning plant erected under economic conditions. Moreover, the material was perfectly clean, requiring little or no preparation before treatment. The recovery of tin from discarded cans presents an entirely different problem. The removal of fat, grease, syrup, varnish, and paper involves the use of a plant of large capacity, consumption of much chemical solution, and a considerable amount of heat. The cost of collecting and transporting bulky material constitutes in itself an economic problem of importance. In a populous centre such as London, it is possible to make contracts with big hotels, and wholesale manufacturers of articles of food, but for the collection of waste tins rejected by the householder recourse must be had to the municipal dust-collector. In the disposal of city refuse, all the metallic articles are thrown into one heap without classification, and the purchaser of scrap has to take the lot. Consequently at the London Electron's place we see a laughable conglomeration of raw material, such as kettles and saucepans, enamelled jugs, galvanized-iron baths, petrol cans, wire of all sorts, salmon tins, and tea-trays. At the de-tinning yard labour is occupied in sorting these and money has to be spent on the carriage of the useless material, each item increasing the cost of operation. Under these adverse conditions it requires some courage to found a business of this character. In spite of the drawbacks the Goldschmidt de-tinning plants in Germany, France, and Limehouse have been profitable, and before the war arrangements had been made to establish two similar enterprises in the United States. With regard to the amount of tin used in making

tin-plate, the percentage varies according to the thickness of the steel sheet and the process of manufacture. Twenty years ago the hand-dipped sheets manufactured in Germany held as much as 5%, whereas nowadays the modern plant in South Wales produces a plate with as little as 1.3% of tin. Probably the average today will be somewhere between 1½ and 2%. As far as we are aware, no one has ever used chlorine as the agent for removing the tin, except Goldschmidt. The caustic soda process, however, has been employed by many inventors who have obtained patents for variants of the electrolytic bath. One notable enterprise founded on this principle is the Vulcan De-tinning Company in America, which by winning a patent lawsuit two years ago forced the American Can Company to close its de-tinning works.

Some doubt may be felt as to the correctness of the new policy of the London Electron Works Company, for it might seem better to sell the business to an English firm prepared to provide capital for the treatment of the briquettes. But here arises the economics of the disposal of the product. The Goldschmidt offer of three years ago was accepted because the tetrachloride of tin produced by the chlorine process was of far greater market-value than the metallic tin produced by the caustic soda process. The tetrachloride was readily saleable at a high price to the silk manufacturers who used it for weighting purposes, whereas the tin produced by the caustic soda process was so easily oxidizable as to require re-smelting, thus greatly reducing its value. As the silk industry in England is of small proportions, it would not be profitable to erect a chlorine-treatment plant with the object of producing tetrachloride of tin to be used in this connection. It is not feasible to reduce the tetrachloride by electrolysis, or otherwise, to metallic tin, for any deposit would be so readily oxidizable as to make it necessary to re-smelt it. We believe, how-

ever, that a profitable industry might be established by making hydroxide of tin from the tetrachloride by a simple treatment with carbonate of lime, as this compound is in demand in connection with the manufacture of enamel. The hydroxide also can be formed easily from stannate of soda, produced in the electrolytic bath. The opportunity presents itself to competent chemists with an adequate supply of capital to acquire the London Electron company's business and help the manager to devise a more profitable method of dealing with the tin scrap.

Mexico.

We publish portions of a letter from a correspondent in Mexico City. It expresses a mixture of bewilderment and contempt. That is the attitude of most of those still able, amid a bigger conflagration nearer home, to watch the development of events in the great mining region south of the Rio Grande. Diaz, Madero, Huerta, and Carranza have succeeded one another with an increasing disorganization of transport and industry, but no evidence of order being evolved out of chaos is as yet forthcoming. The most promising sign is the fact that Zapata, a bandit now successfully at large for four years, has protested to General Funston against the withdrawal of the American troops stationed at Vera Cruz, this Mexican 'reformer' preferring American troops to those of the party headed by General Carranza, the President *de facto*. That way lies the only solution of the problem. Each successive regime becomes less representative and less effective. Huerta at least maintained order in the South, while Carranza was on the war-path in the North. Now the South is as much disorganized as the North. Zapata, Villa, and Carranza appear to have an equal chance of holding their own. Not one of them is likely to gain the upper hand, so as to be able to control the administration of the entire country. Meanwhile the national treasury is

depleted, the credit of the republic has vanished, and continued brigandage is bringing the people to abject poverty. If only the other leaders would act on Zapata's hint and prevail on the American troops to restore order, the country might hope for peace and prosperity once more. The United States must Egyptianize Mexico, not annex it, but exercise benevolent supervision, stand at the right hand of the administration, and provide the troops required to check revolutionary outbreaks. President Wilson has won his point; Huerta has gone; no Mexican president can borrow capital without American recognition, and no Mexican government can enjoy any credit unless it is supported from Washington. That is a great step forward in rendering unprofitable the military assaults on the presidency, hitherto the usual manner of obtaining political control. Now that the treasury has been emptied, it is impossible for the Government to retain such an army as is essential to the maintenance of order. We see no solution of the problem save that to be provided by the United States. President Wilson has placed his hand on the plough; he must finish the furrow.

Lead Smelting.

In our last issue we discussed the erection of zinc-smelting works in England to treat the Broken Hill zinc concentrate formerly shipped to Germany and Belgium. We shall address ourselves now to the kindred problem of a proposal to erect smelting works for the treatment of the Broken Hill lead concentrate now similarly seeking a new market by reason of the war. As most of our readers are aware, the Broken Hill mines, besides a small and diminishing output of oxidized ore, yield sulphide ore from which, by wet methods, two concentrates are obtained: one chiefly valuable for its lead, and the other for its zinc content. The total production of lead concentrate is 350,000 tons. Of this total the

Port Pirie and Cockle Creek smelters treat about 200,000 tons, leaving 150,000 tons for export to Europe. As exported this concentrate averages about 65% lead, 6% zinc, and 25 ounces silver per ton. The Broken Hill Proprietary and Sulphide Corporation are willing and able to treat the whole output of lead material mined in New South Wales, and they have made bids to the other companies, but the terms offered by them have been less favourable than those hitherto obtainable in Europe, chiefly in Germany.

The lead-smelting industry of Great Britain has declined steadily during the last thirty years, the output of lead for 1913 being about 30,000 tons, of which 19,000 tons came from local ores and 11,000 from imported ores. Lead mining is an ancient industry in this country, dating back 2000 years at least. A hundred years ago the yearly output of the metal was 40,000 tons, and the figure gradually rose until 1868, when 71,000 tons was produced from home sources. In that year, 58,000 tons of lead in the form of bullion and ore was imported, and 51,000 tons was exported as manufactured goods and paint. During 1913 the importation of lead in pig and sheet was 200,000 tons, while 30,000 tons was exported as pig and 17,000 tons as manufactures.

In considering the home production of lead ore, we find that sixty years ago 330 mines were making returns, as compared with 55 last year. The most important mines are in the Pennine chain extending from the Scottish border to the south of Derbyshire. Here the galena is found as a replacement in Carboniferous limestone. The same conditions exist in the northeastern Welsh counties of Flint and Denbigh, and in Somersetshire. In Central Wales, the Isle of Man, southern Scotland, and Ireland the ore deposits are in shale of Silurian and Ordovician age. Some silver usually accompanies the galena, but the proportion is never high, 10 or 12 ounces per ton

being the maximum. At one time a considerable amount of lead was produced in Cornwall. According to such statistics as are available 50 mines were at work in 1856 and the output of galena concentrate was 13,000 tons. The ore produced in Cornwall carried much more silver than the galena mined in other parts of the kingdom, some of it assaying as much as 100 ounces per ton. The richest mines were in the district east of Liskeard. About a dozen years ago a modern dressing-plant was erected under the direction of the late Henry Ryan Lewis at Menheniot to treat some extensive dumps, and we believe a substantial profit was made. No lead is now being produced in Cornwall.

The Home Office returns state that 26 lead smelters are in operation in this country, but most of them are conducted upon an insignificant scale. Many of them are manufacturers of lead sheets and tubes, or of white lead and the allied paints, and others are refiners of antimonial lead and silver bullion. Two smelters in Derbyshire treat local ores, and the Weardale, Leadhills, and Greenside mines in Durham, Lanark, and Westmorland, respectively, smelt their own output. There are custom smelters at Swansea, Flint, St. Helens, Bristol, and the east end of London. The imported ores come from Peru and other South American states, from Western Australia and New South Wales, North Africa, and Rhodesia. Of the imported pig and sheet lead the figures are roundly 75,000 tons from Spain, 55,000 tons from New South Wales, 30,000 tons from the United States, and before the revolution, 20,000 tons from Mexico. An examination of the statistics of the world shows that the United States is the largest producer, with a yearly output of 400,000 tons. This is almost entirely absorbed by the domestic demand, and there is little surplus for export. Missouri, Utah, Colorado, and Idaho are the leading producing states, and the great smelting centres are Salt Lake City, Kansas

City, Pueblo, and San Francisco. Spain comes next to the United States and New South Wales as a lead producer; the mines and smelting works in Spain are largely controlled by French, German, English, and Belgian capital; we refer our readers to a timely article on 'Lead Mining in Spain' in our issue of May last, written by Mr. E. Mackay Heriot, who, by the way, was taken prisoner at Clausthal on the outbreak of the war and only recently returned to this country. The yield of lead in Germany from domestic ores is 90,000 tons per year, and a similar amount from imported ore, while the import of 90,000 tons of metal and the export in manufactured goods of 40,000 brings the total consumption to 230,000 tons. The chief lead mines in Germany are in Silesia, Rhenish Prussia, and Nassau. The Broken Hill concentrate that goes to Germany is smelted chiefly in Rhenish Prussia. Belgium produces little or no ore, but the smelters at Liège extract 50,000 tons from imported ore, and 10,000 tons of manufactured lead is exported. Italy has two important lead mining and smelting centres at Pertusola in Tuscany, and Monteponi in Sardinia. The total output of Italy is about 21,000 tons per year, and imports bring the consumption to 32,000 tons. A comparatively small amount of lead ore is produced in France, but the smelters at Cuérnon and Pontgibaud treat ore obtained from Tunis and Algeria. The output of the smelters is about 30,000 tons, and about 70,000 tons of metal is imported. The Greek output comes chiefly from the ancient mines at Laurium, and the yearly production is about 18,000 tons. Austria-Hungary produces 24,000 tons of metal from local ore, and Asiatic Turkey 13,000 tons. Of countries in other parts of the world not already mentioned, Mexico, before the revolution, had an output of 110,000 tons per annum. The figures for British Columbia for 1913 were 17,000 tons and for Japan 3500 tons. For the last seven years the world's out-

put has been fairly steady at 1,100,000 tons.

Obviously, if Great Britain consumes twice as much lead as that derivable from the lead concentrate that passes our ports on its way from Broken Hill to the Continent, it is about time to consider the domestic treatment of this output. If the two Australian smelters could decrease their rates, they might smelt all of it, so that the question would not arise. But the uncertain and expensive labour employed at Port Pirie and Cockle Creek militates against economical results. Moreover, the freight, insurance, and interest charges are considerably more on bullion than on concentrate. Then the question arises whether it will be economical to send the concentrate here for treatment; the reply must be in the affirmative, seeing that it has proved profitable to send similar material to Germany. If the business is undertaken, it will be advisable to model the plant on Australian and American practice, namely, to pot-roast in furnaces of the Huntington-Heberlein or Dwight-Lloyd type, and then reduce the resulting agglomerate in blast-furnaces. The sulphur should be utilized in the manufacture of acid. Desilverization of the lead must be performed by the Parkes process. On a rough estimate the total outlay, for a capacity of 1000 tons of Broken Hill lead concentrate per week, would be under £50,000 or barely 30 shillings per ton of lead output per annum.

Zinc Smelting.

Sundry criticisms having been directed, we are informed, against our estimate of the total capital outlay required for the establishment of a zinc-smelting enterprise, we are fortunate in being able to publish a timely letter on the subject from Mr. H. M. Ridge, an acknowledged specialist. Our own figure of £40 per ton of zinc per annum was based mainly on the records of the Seaton Carew plant, for it will be agreed among engineers that the actual cost of a smelter is a better

guide than any academic estimate. Mr. Ridge states that the investment made by the two companies working at Seaton Carew amounts to £36. 7s. per ton of zinc smelted annually. Our own reading of the figures available, part published and part unpublished, was that the total sum expended was fully £3 more. Mr. Ridge's revised estimate for a new plant is £30 per ton, on the assumption that metallurgic art has progressed and that the Seaton Carew expenditure involved sundry unexpected items. We submit that there never was a plant erected anywhere without the incurring of some unforeseen expenditures, and that while those that burdened Seaton Carew may be avoided, others are likely to intrude. Again, we note a most timely article on the Rose Lake zinc plant at St. Louis by Mr. E. H. Leslie in the *Mining and Scientific Press* of September 12. The Rose Lake smelter, just completed but not yet in commission, cost \$1,500,000. It has a capacity of 100 tons of concentrate per day, but this concentrate is unusually clean, for it averages 65% zinc, 30% sulphur, and contains only traces of lead, without any silver. Only the distillation of the zinc is required; the refining of the zinc and the treatment of retort-residue being omitted. Thus a considerable item of capital outlay is obviated. Broken Hill concentrate averages 45% zinc, 6% lead, and 9 ounces of silver per ton. For a given output of zinc, the retort capacity would be 50% more than at Rose Lake, besides which a concentrator for the silver-lead residue from the retorts would be necessary, together with a lead-smelting furnace, and a refinery and desilverization plant for the lead in order to make the operation complete. The Rose Lake plant treats 100 tons of 65% zinc concentrate, from which the actual yield of metal would be about 58 tons per day. Allowing for interruptions and repairs, the production may be estimated at 18,000 to 20,000 tons per annum. Thus the capital outlay of \$1,500,000 is equal to £16

per ton of zinc in a 65% concentrate. This is equivalent to over £25 on the basis of a 45% concentrate. If we add the cost of site, railway communication, residue concentrator and furnace, lead refinery, and desilverization plant, with staff and workmen's buildings, none of which are included in the Rose Lake expenditure, we should conclude, from this example, that the cost of erecting a complete zinc-smelting establishment in Great Britain would be about £32 per ton of zinc. If lead-smelting is to be undertaken in England for the treatment of the concurrent lead concentrate from Broken Hill, it would be advantageous to co-ordinate the two enterprises, and to erect the two smelting establishments on adjoining sites, so that the lead-silver residue from the zinc retorts could be treated on the spot as part of the charge to the lead-furnace. At the present time the Seaton Carew smelter has to sell its lead-silver residue, some going to Germany and some to east London. It may be argued that it is not correct accountancy to debit the smelter with the cost of winning the lead and silver in the concentrate, but we submit that the latter is an essential part of the process viewed as a whole, and that Anglo-American metallurgical enterprise fails in this very respect, as compared with German practice, namely, we are not sufficiently careful to benefitiate the by-products.

Nigerian Regulations.

Complaints come to us against the inconsiderate treatment of the tin-mining industry in Northern Nigeria. The dilatory administration is claimed to be a real hindrance to further development. Of course, the climatic conditions are inimical to excessive energy, and officials in a Crown Colony are apt to have a geological valuation of time, but, even after making such necessary allowances, it seems clear that the mining industry is not being fairly treated. When the first mining

regulations were framed and the first inspectors set to work to apply them, it was hardly supposed that the search for tin would assume such extensive proportions, but it has long been evident that insufficient provision has been made for the growth of the new industry. Surely the inflow of capital and the building of railways cannot have been without significance to the Colonial Office. Nevertheless, matters were so mishandled that soon the pegging of claims and the overlapping of titles taxed the Survey Department. Instead of increasing the staff promptly, the accumulation of work was allowed to proceed until it became necessary to close 80% of the tin region in order that a so-called 'Minefield Survey' could be made. This was at the end of 1912. Now, nearly two years later, the block has not been relieved. The granting of leases was stopped, so that all prospecting operations were suspended except on leases that had been granted before the proclamation. Those to whom the exclusive prospecting licenses had been granted previously are unable now to obtain the actual leases without which no security of title is possible. As the survey has proceeded on its slow and laborious way during the two years, no relief has been given, for all must await the completion of the entire work. This, in its illogical stupidity, is worthy of the proverbial Chinese mandarin. By such obtuseness the Government prevents the extraction of tin, with the rent and royalties incidental thereto, and compels capital to lie unfruitful, if not wasted; for the administrative expenses of the mining companies continue during the interval. Should this Minefield Survey—a bit of inexcusable jargon—be completed next year, there will still remain the accumulation of lease applications, which, in the absence of a sufficient staff, must entail further irritating delays. We may cite the case of a syndicate that obtained an exclusive prospecting license, caused the leases to be surveyed, and made the usual application to

the Mines Department. The reply came that the survey must be made again by a licensed surveyor. This was done. Then the Inspector of Mines goes to the property, inspects, and approves. The syndicate prepares to start mining operations. Meanwhile, after all these formalities, the application goes to Zungeru, the official headquarters, but is refused "pending the minefield survey." Why should the mine operators have been compelled to go through all these motions if in the end the leases were to be so delayed? Subsequently the syndicate was notified to make a fresh application, entailing the clearing of tracks and the erection of new beacons. And these beacons, if you please, were to be made of cement, which costs £25 per ton in Nigeria! This policy of suspense is killing the vitality of a beneficent industry. It is without excuse. We understand that the officials of the Mines Department and the political authorities at Zungeru are not sympathetic; then let the Colonial Office see that this is remedied, for the idiosyncrasies of these gentlemen should not be permitted to damage the welfare of a whole province. The royalty is shared equally by the Government and the Niger Company, which is also an important factor in the Chamber of Mines, but it cannot be supposed that the Niger Company is working against the mining industry, for the company's trade benefits directly from the exploitation of the tin region. When the tin mining began the Niger Company engaged a mining engineer to formulate mining regulations based upon the experience of other countries, and his recommendations were accepted, but the Colonial Office made an abortion of them. Hence, in part, the later troubles. The Governor of the Colony, Sir Frederick Lugard, is desirous of helping the mining industry, but he appears unable to do anything. It is a regrettable exception to the excellence of our colonial administration, and calls for urgent attention.

Cyanide.

Gold mining, in its world-wide aspect, depends largely on a supply of the chemical that is the chief reagent in the process of leaching first developed by MacArthur and Forrest in 1886. About one half of the total requirement of cyanide outside the American market was being supplied from Germany before the war, while as much as 65% of the consumption on the Rand came from that source. In Great Britain the Cassel Cyanide Company, at Glasgow, and in America Roessler & Hasslacher, at New York, are the chief manufacturers of this important chemical, the latter taking care of the bulk of domestic demands. As we stated in our last issue, arrangements have been made with the Cassel company for supplying the South African mines at a price about 20% higher than that prevailing before the war. The German contracts made by the principal Rand groups expire in 1916, and the new contracts stipulate for a gradual reduction in price from 8½ pence per pound to the 7 pence heretofore charged. The increased cost of raw material and the heavy commitment for new plant are given as reasons adequate to explain the increase in price. We are assured that no 'ring' exists, only an understanding comparable to that between Germany and England in regard to naval construction, an understanding from day to day, varied by continuous competition, the general effect of which has been to lower the price from 2s. to 7d. per pound in the course of 20 years. It is claimed that a further decline would have been highly prejudicial to the British chemical trade, which is stated to be handicapped in competition by the fact that the German government gives financial support to industrial chemical enterprise to such an extent as to facilitate undercutting of prices for periods long enough to put foreign competitors out of business. On the other hand, the Cassel company has managed to do very well on the manufacture of

cyanide, paying 3s. 6d. per annum on its 5s. shares, which, it is true, formerly had a denomination of £1 and were reduced when the cancellation of the MacArthur-Forrest patents in South Africa, Australia, and Mexico caused a severe loss of revenue; but we cannot see that this company has done aught but well since it began to manufacture cyanide, and we see no reason why it should not continue to do so. We hope it may expand, so as to be able to supply all the requirements of British precious-metal mining. The Cassel company first made commercial cyanide by the treatment of prussiate obtained as a by-product in gas-works, then it adopted Mr. George Beilby's synthetic process, and now employs one based on the Castner and Beilby processes. The Cassel plant at Glasgow is the largest individual cyanide factory in the world, and is being operated to full capacity. We are informed that no mine, outside Mexico, need be troubled for lack of cyanide. It is estimated that about 1000 tons of the chemical was lying at or near Mexican ports at the beginning of August. Most of this has since been distributed in Mexico. As our readers are aware, the ores of silver involve much greater consumption of cyanide than those of gold, the ratio being about 4:1; on the Rand the consumption is about half a pound per ton; at Pachuca it ranges from 2 to 3 pounds per ton of ore. This fact has proved important in another way: the output of cyanide was reduced when the blockade in Mexico closed that market, so that the war found all the factories in Scotland, Germany, and America running at low capacity. This was accentuated by a reduced demand from South Africa during the first six months of this year, some of the mining companies on the Rand having decided to carry smaller stocks. As regards the production of cyanide from calcium cyanamide, we note that the American technical press is holding out favourable hopes. Our own in-

formation is to the contrary. Cyanamide is a compound of cyanogen and amine molecules, and has the formula $CN.NH_2$. One or both of the hydrogen atoms of the amine can be replaced by a metal. Thus we have $CN.NHNa$, cyanamide of sodium, and $CN.NCa$, cyanamide of calcium. This latter substance is the cyanamide used as a fertilizer and produced on a large scale in Norway and the United States. Its virtue as a fertilizer is due to the fact that on contact with moisture it releases ammonia. When heated with carbon to a high temperature it is converted into cyanide of calcium, which in turn can be converted into cyanide of sodium by treatment with a sodium salt such as the sulphate or carbonate. The reaction to produce cyanide from cyanamide requires so great a heat as to be commercially impracticable. It is easier to effect the opposite process, producing cyanamide from cyanide. When Frank & Caro started their process, for treating calcium carbide with nitrogen, their objective was the production of cyanide of calcium, and the formation of cyanamide of calcium was in the nature of a surprise. The American Cyanamide Company placed on the market a year or two ago a compound produced from cyanamide containing about 20% of sodium cyanide, called 'surrogate.' This is produced by feeding a poor quality of cyanamide into a bath of molten sodium chloride. It is extremely doubtful whether such a product would be acceptable to the metallurgist, and in any case it is not being made at present. We may safely say, therefore, that there is no immediate prospect of cyanamide becoming useful directly or indirectly in the treatment of gold and silver ores.

According to the *Mining and Scientific Press*, just to hand, the American minister at Berlin was informed on the 16th ultimo by the director of the Gold und Silber Scheide Anstalt that the export of cyanide is now permitted to the United States and Mexico on condition that it is not re-exported. Ship-

ments will be made presumably through Holland and under a neutral flag. We understand that at the outbreak of war the German firm above mentioned had large stocks of cyanide on hand, and, therefore, if transport is available there should be no scarcity of the chemical either in the United States or Mexico even if the German factories shut-down in the interval.

The Hour of Destiny.

Just before going to press, and too late for an ordinary review, we have received a copy of the book by Colonel H. Frobenius that elicited enthusiastic commendation from the Crown Prince of Prussia. This book was published as recently as last July and has been translated, for John Long, Limited, by Mr. W. H. Behrens, a solicitor well known in the City; it is called 'The German Empire's Hour of Destiny' and represents another announcement of the Prussian programme. Bernhardt's book was issued in 1911, and this up-to-date pronouncement serves to prove that the plans of the Potsdam military bureau had not changed during the interval. The idea is still to smash France first and then dispose of Russia; and having done that, to destroy the British empire, and so make way for the world-wide domination of German *kultur à la* vulture. Frobenius makes the same mistake as Bernhardt: he assumes that England will play the part of a craven and hesitate to assist her allies. It is "quite out of the question, of course," he says, to suppose that "Great Britain would unselfishly devote her forces to the interests of France." He also assumes that Great Britain will attack Germany "unawares" and "deliver her declaration of war with the first shells at our coast resorts." Apparently he judges other governments by his own. These apostles of brute force, of biological necessity, and of relentless aggression make curious blunders. Their political calculations have miscarried because they assume that no moral forces

exist. As Sir Valentine Chirol says in his preface to this book: "No doubt in a world ruled wholly by brute force, as the world would be if they had their way, they would be right, for all moral forces, ponderable or imponderable, would have ceased to exist." In his treatment of England's part in the impending war, Colonel Frobenius uses 'The Day of the Saxon,' a book published last year, and written by Homer Lea, as his text. He also quotes J. S. Corbett's 'Some Principles of Maritime Strategy.' His discussion of military problems is impressive and ought to prove interesting to our leaders. But he assumes that England will violate the neutrality of both Holland and Denmark, and thus creates for himself conditions that are imaginary. Throughout the book it is obvious that the little Nations are regarded as pawns in the sanguinary game to be played by the big Powers.

In the chapter on Russia the author adopts Bismarck's point of view and quotes freely from the Iron Chancellor's 'Thoughts and Recollections.' The trouble between Russia and Germany is said to have begun at the Berlin Congress. The effort to reach warm water is recognized as the *motif* of Russian expansion, to Port Arthur, to Constantinople, and to Narvik, menacing in turn Japan, Turkey, and Sweden. To us the effort not only of the Russian government but of the Russian people to obtain a hospitable coast is reasonable and justifiable. Lord Salisbury put his money on the wrong horse indeed when he backed Turkey in 1878. Undoubtedly the war, if it ends as we hope, will recognize this need of the Russian nation. In the chapter on France a proper emphasis is placed on the low birth-rate and the comparatively rapid gain of Germany in point of population. Since 1875 the increase in France has been 7.6%, and in Germany 58%. To counteract this loss of recruiting power, France introduced the 3-year service, thereby increasing her stand-

ing army so that it slightly exceeded Germany's, but this drain on the industrial activities of the country was such, asserts Colonel Frobenius, as to hasten the inevitable Franco-Prussian struggle. He argues, however, that the 3-year service not having become fairly started, it will be necessary in 1914 to train two annual drafts at the same time by means of those that have served one year, making it "impossible for the French army to engage in the war at the present moment." The book was published in July; the war began in August. Evidently the author was mistaken. He gives 1915, or 1916, at the latest, as the year of the Great War. The author reverts to the neutrality of the small nations and asserts that England has no regard for such conventions; moreover, he argues that England will not "exhibit opposition to a violation of neutrality." The events of the first four days of August prove that he made another capital error. He assumes, moreover, that there will be an insurrection against German rule in Alsace and Lorraine in the early days of the war. He must have had in mind the Zabern affair. This forecast also was not fulfilled, largely owing to the prompt advance of the German armies, preventing the French from inciting or aiding the disaffected. The author's comment on the character of warfare as modified by the moral qualities and physical fitness of the individual soldier are justified already. Indeed, the book, from the military standpoint, will command respect, but it exhibits no appreciation for the sanctity of treaties, the principle of right, or the instincts of honourable dealing; it is another expression of the piratic idea of Prussian militarism and closes with the appropriate words: *Si vis pacem, para bellum*. As a timely statement of the German case, it is deeply interesting to every serious Englishman, now at last awakening to the deeply-laid plans of Pan-Germanic aggression.



SPECIAL CORRESPONDENCE

TORONTO.

Porcupine.—Production of gold has been greatly stimulated by the demand created by the war, the smelters being eager to take gold ore, especially high-grade. Some of the smaller properties are being actively developed, and are expected to become producers before the end of the year. The August output of the Dome shows the largest monthly production since January, amounting to \$90,893 from 20,170 tons of ore averaging \$4'50 per ton. The 4-weekly statement of the Hollinger for the period ending August 12 showed a gross profit of \$171,975 from the treatment of 16,456 tons of ore averaging \$15'46 per ton, the approximate extraction being 94'04%. The working cost was \$4'16 per ton milled. The profit from January 1 to August 12 is \$1,015,451, of which \$720,000 has been paid in dividends. Robbins, the manager, reported 60 stamps in operation, and encouraging results from underground work. The vein on the 675-ft. level has widened to 20 ft. of ore averaging \$10'90 per ton. A winze is being put down from the 675-ft. to the 800-ft. level. The Rea mine is being worked, and has a 10-stamp amalgamating mill in operation, which crushes 35 tons daily with a monthly return of about \$15,000. At the Dome Lake, now controlled by the Hudson Bay of Cobalt, developments at the 180 and 300-ft. levels have proved sufficiently satisfactory to encourage the management to have the mill put in condition for starting next month. The Little Pet is now on the list of producing mines. It has a little 2-stamp Nissen mill, and a clean-up after a 20-day run yielded \$4000. A rich ore-shoot has been opened up on the 50-ft. level. After being idle for some time the remodelled Vipond mill has been re-opened with a cyanide annex. It has a capacity of 150 tons per day. The McIntyre property is now under option to the Nipissing Co. of Cobalt, which has agreed to take 150,000 shares at 40 c. per share, giving them a controlling interest, provided an examination now being made by Morton Webber proves satisfactory.

The purchasing company is also to take over McIntyre bonds of the par value of \$90,000. An additional unit of the McIntyre mill has gone into operation, which will give the plant a crushing capacity of from 250 to 300 tons daily. At the Teck-Hughes, on Kirkland lake, which is also under option to the Nipissing, with Harry Keyes as manager, another vein 6 to 8 inches wide has been found on the surface running parallel to the main vein and 60 ft. south. A cross-cut is being run to pick it up on the 75-ft. level. Shipments of high-grade ore are being made from the Tough Oakes.

Cobalt.—The district has now recovered from the depression following the beginning of war, and shipments of ore are now normal. Bullion is again being sent out to some extent, though the Nipissing, the largest shipper, is storing most of its bullion until market conditions improve, and some other producers are adopting the same course. The Nipissing has declared its regular quarterly dividend of 5%, and its financial position shows a slight improvement, the balance on hand on September 8 being \$1,364,929, of which \$730,149 is cash. Vein 98 has been proved by drifts and rises for 540 ft. and a depth of 65 to 80 ft., much of it being in condition for stoping. The Kerr Lake after a shut-down of about three weeks resumed with a complete staff. The Casey-Cobalt, which largely curtailed operations, is now working on a two-thirds basis, employing 10 drills in place of 15. The Crown Reserve is again in operation with a full force, and is meeting with good results from exploration work on the 200-ft. level. It has declared its regular 2% monthly dividend. The Glen Lake, operating the old Foster mine, is drilling on the 200-ft. level to follow a vein underneath the lake, where there is a deep conglomerate formation. The proposed sale of the Bailey property for debt is being strongly opposed by a number of the shareholders, who have formed a protective committee to safeguard their interests, which, they assert, are being needlessly sacrificed.

New Opportunities.—The cutting of all imports from the European continent has opened a large market for many mineral products that can be supplied in Canada and will stimulate some branches of the mining industry hitherto neglected. Supplies of arsenic are getting scarce, and a substitute for the imported article may be obtained from the extensive deposits of arsenical ore in Hastings and Frontenac counties, Ontario. In some places this mineral is found in association with gold sufficient to defray the operating cost. The Ontario government grants a bonus of \$10 per ton for white arsenic. Nova Scotia has also some good arsenical ore on the Eastern coast. There is a marked shortage of antimony, large quantities of which come from Austria-Hungary. A supply is obtainable from New Brunswick and Nova Scotia, where some of the deposits have been extensively developed and could be operated at once. The United States has been importing potash salts from Germany to the amount of about 900,000 tons annually, and it is expected that the large felspar deposits of Eastern Ontario will be drawn upon to supply this demand. Other minerals that can be furnished in Canada and are likely to be much in requisition under present conditions are chromite, magnesite, molybdenite, and wolframite.

SAN FRANCISCO.

War's effects are felt throughout the Western mining states, though it is too early to say what the final result will be. The big outstanding fact now is that the copper mines have reduced their output and set many workmen adrift. While domestic consumption has held up better than had been anticipated and shipments to Europe in August were surprisingly large all things considered, the copper industry is hard hit. On the other hand zinc, quicksilver, manganese, and other metals are in increased demand. There is little zinc mining on the West Coast, but in the Middle West and the Rocky Mountain region the rise in price has set many men to work. In California the jump in price from \$37.50 to \$85 and \$95 per flask has naturally cheered quicksilver producers. Coming after a long period of low prices, this rise was particularly welcome to them. The demand for ferro-manganese caused a scramble in the eastern states and will help iron-ore producers, especially on the new Cayuna range in Minnesota, where manganese-iron ores are abundant. In California the electric furnaces of the Noble Electric Steel Co., on Fit river, in

Shasta county, were promptly set to work making ferro-manganese. It seems probable that this will prove a permanent industry and that in the making of special alloys rather than the cheaper pig-iron, this and other furnaces will find their chief field for some years. Gold and silver mining have been hurt more than they have been benefited so far, though, in the end, it is felt that the advantages of gold mining as compared with other forms of industry will be made clear to many investors by this war. Already such surplus funds as are available are beginning to flow toward the gold mines. For the present a shortage in zinc-dust and cyanide is being keenly felt. The first can be easily supplied and the New Jersey Zinc Co., Illinois Zinc Co., and other equally responsible concerns, have announced that they will shortly be in the market with American zinc-dust. Cyanide, however, is another matter and it will be January at least before any considerable supply can be anticipated. In the petroleum field the war has had little immediate effect. Gasoline is still being sold for 13½ cents per gallon and the price of crude remains about where it was. M. L. Requa and his associates are working hard on the valuation of the properties of the Independent Producers Association, and Andrew Weir is expected in California shortly in connection with General Petroleum matters. The contract for a pipe-line from the oil-fields to San Francisco bay has been let by the Royal Dutch-Shell interests, and development goes on steadily. An excellent oil exhibit at the Panama-Pacific Exposition is now assured through the assistance of the Standard and Union companies. The one has undertaken a complete exhibit in the Mines and Metallurgy building and the other will build an equally complete oil-camp outside, showing every operation from drilling to refining. The Exposition, as your readers probably have already heard, will open on time, with buildings complete and full, despite the regretted absence of some exhibits that had been planned by our friends now at war.

Alaska too, presents a cheerful picture. There have been no electrifying discoveries this season, but good progress and fair clean-ups are reported from all around. A rumour of a great discovery at Broad Pass, credited to a message from Stephen Birch, was promptly denied by that experienced and capable Alaskan, but it is probable that some of the prospectors who this year swarmed out along the lines of survey of the Government railway, will return with substantial rewards. At the

close of each season there are always true as well as false announcements of discoveries. At Juneau, work at the big plants is proceeding according to programme. Robert Kinzie, after 13 years notable service as manager at Treadwell, has resigned and returned to California. Just how rapidly that great enterprise has grown is shown by the facts that when Mr. Kinzie went to Treadwell underground mining in the Alaska Treadwell, now down

Bratnobar, whose career is so well known to English mining people as to require no obituary. He died at Livermore, California, on September 13, at the age of 65, preserving his active pioneer spirit to the last. Another notable death in the annals of mining was that of James B. Haggin, the senior partner of the Haggin-Hearst firm that developed so many of America's great mines. Haggin's interest in mining continued to the day of his death, de-



THE BIG OPEN-CUT AT TREADWELL.

1750 ft., was just beginning. In the Ready Bullion the work was on the 350-ft. level, while it is now down 2200 ft. Millions of tons of ore have been mined and milled, but Mr. Kinzie leaves the mine in excellent shape with nearly a million tons of ore broken and ready for his successor, P. R. Bradley, to extract. Mr. Bradley, it is understood, will have charge of both the Treadwell group and the Alaska Juneau, but his assistants have not been announced. E. P. Kennedy and W. P. Lass also leave the Treadwell to take up work for themselves, especially the development of the Speel river power-project, which is big with possibilities. Alaska, as well as Mexico, has just lost a pioneer in the death of Henry

spite the fact that he was born in 1827. The Cerro de Pasco was his last great venture, and to it he gave constantly and freely of time, energy, and funds. The pioneers are passing away rapidly.

Labour troubles are decreasing. After a long period of peace under the policing of United States troops, both operators and men in the Colorado coalfields show a conciliatory attitude and are in conference with the President with a view to settlement. At Butte state-troops are in control and have behaved excellently. The row between the old Western Federation and the new Butte Mine Workers' Union convinced the companies that there was little to choose between them,

and as a result they have all joined in formal notice that neither union will hereafter be recognized. It is too much to say that this means that Butte will at once become an 'open' town. The other unions are strong locally, and, in fact, that is one of the difficulties, since union miners earning \$3.50 per day have been compelled to pay union tradesmen and workers as much as \$8 per day. These conditions are bound to change, since the system has rested not only upon public consent but upon successful terrorism. The change at Butte, however, does seem definitely to mark the end of power for the Western Federation of Miners. In the meantime the companies guarantee maintenance of hours and wages heretofore existing.

Peace in Mexico forms a welcome contrast to war in Europe. Whatever may be true six months or a year from now, it is undoubtedly true now that the new administration is fully in the saddle and is vigorously at work restoring lines of communication and otherwise making possible re-establishment of the ordinary industries of the country. The first through train from the City of Mexico to El Paso arrived on September 23, and re-establishment of service on the Southern Pacific line down the West Coast is being accomplished so rapidly that through trains may be running before this reaches the reader. Every boat and train is carrying back to Mexico some of the mining men who were driven out by the revolutions. The A.S. & R. Co. reports four out of six furnaces at Chihuahua operating and a fifth ready to be blown in. This is typical. Many of the mines are hampered by lack of supplies and the Cinco Minas has not been able to resume for lack of cyanide. These things will right themselves in time and meanwhile a great deal of reconstruction is under way. It is one of the sad features of the situation that Albert Grothe, so long and favourably known among Mexican mining men, to most of whom he was 'Don Alberto,' should have died just as conditions were changing for the better.

NEW YORK.

The Nipissing Mines Co. has taken a two-months' option on 1,501,000 shares of McIntyre stock, at a price said to be 40 c. per share, payments to be made in instalments of \$200,000 each at two-month intervals. Morton Webber, with a corps of assistants, is now engaged in valuing the mine for the Nipissing interests, and if the ore reserves prove equal to the vendor's representations the option will be promptly

exercised. This is the first venture of the Nipissing into the Porcupine district and it is interesting that its attention is directed toward promising properties instead of mere prospects. The Nipissing has been doing well lately, production for June being \$184,000 and estimated profit \$107,000; July production was \$211,600 and profit \$131,800. The war has not affected operations, as the mine has enough cyanide on hand to last until the middle of February, and shipments of bullion are being made regularly to Europe, the increased charges due to war risk only amounting to a fraction of a cent per ounce of bullion.

Cyanide.—American operators are finding a lot of comfort in the announcement that the Cyanamide Co. of America expects to be turning out large quantities of low-grade sodium cyanide, at a price equivalent to 8 c. per pound of KCN, not later than the first of the year. This company is now engaged in the production of large quantities of cyanamide, which is used as nitrogenous fertilizer, at its plants at Niagara Falls and in Tennessee. It has been found that if the commercial product is dissolved in a fused bath of NaCl the cyanamide unites with the free carbon forming cyanide, and a crude sodium cyanide, containing 30 to 50% equivalent KCN is produced, at so low a cost that it can be sold cheaply. There is some question as to whether this low-grade material will be satisfactory, but the margin of price is sufficiently great, so that operators can afford to go to some extra trouble in using it. It should completely relieve the cyanide shortage, if it can be used, and will greatly assist the many plants in Mexico now hoping to start again soon, and which for treating silver ores require much larger quantities of cyanide than the gold mills.

Copper.—The First National Copper Co., of Coram, California, has completely closed down, having discontinued its shipments of ore to the Mammoth plant at Kennett, California, and to the smelter at Thompson, Nevada. Great hopes were entertained of an early resumption of operations by the First National, which is better known by its previous name of Balaklala, when it was announced last year that large-scale experiments were to be made with the Hall process for eliminating sulphur dioxide from smelter-fume. The difficulties raised by the farmers in this district are too well known to need reference, and the Hall process, which aims to oxidize the metallic bases without oxidizing the sulphur, offered the possibility of working the copper ore, and perhaps even producing

sulphur at a small profit. The experimental work was done under the direction of H. F. Wierum, a well known metallurgist. It was found perfectly possible, using an 18½ ft. McDougall furnace, and the requisite oil-burners and steam-jets, to roast 40 tons of ore per day from 35 to 55% sulphur, making a gas that only contained 0.3% sulphur dioxide. The device provided for collecting the sulphur proved a complete failure, however, and the First National did not take up the process, probably being deterred by the fact that at recent prices for copper there is little chance for profit in the operation of their mine. The

for the power-house, transmission line, and electrolytic plant had been bought in Germany, but fortunately it had nearly all been shipped, and was either at Tocopilla or on board Chilean steamers when the war broke out. It is possible that even the small amount not yet shipped can be forwarded through a neutral port, and, if not, the American plants affiliated with the German company will undertake delivery. The difficulty with the management of the Antofagasta-Bolivia Railway Company has been practically settled, and was, indeed, never so serious as it appeared. When the railway was built it secured



MEXICAN ARTILLERY.

rights to the Hall process in Europe are owned by the Sulphur Co., Ltd., and it is understood that the building of a 50-ton plant at Sulitjelma was about to be begun when the outbreak of war stopped everything. The process seems to be one of decided possibilities and is well worth watching, especially now that the demand for sulphuric acid for leaching purposes seems likely to make the production and distribution of sulphur of more interest to metallurgists.

Chuquicamata.—The incidence of war has not had any marked effect on construction and development work at Chuquicamata, and it is hoped that it will be possible to start the first unit of the leaching plant some time during next March. The electrical equipment

permission from the Chilean government to dam the Loa river to secure a water-supply for the line, and in return for building the dam it secured the use of a part of the flow of the river for its own use, the rest remaining the property of the government. When the Chile Copper Co. secured the right to use this water the railway company brought an injunction suit, which has since been settled. Even if the Chile Copper Co. has been unable to secure the gravity supply from the Loa river it could have secured a sufficient supply by pumping from a point within its own property, and there is a third source of water-supply also available, but at a considerable distance. The pipe has been delivered and is now in process of being laid.

Braden Copper Mine.—Mining operations at the Braden have been much interrupted by an unusually hard winter, but the output for August, which marks the end of winter, was 1,532,000 lb., the largest in the history of the company. This was due, though, to a clean-up round the smelter. The output for the first 8 months of this year has amounted to 18,315,000 lb., as compared with 11,056,000 lb. last year for the same period. The mill-recovery during August averaged 72.7%. Shipments of blister copper have been diverted from Europe to New York.

Nickel.—A few years ago the International Nickel Co. began marketing a part of its product in the form of a new nickel-copper alloy, which it named, in honour of one of its directors, Monel metal. Uses for this have been sought and an additional one has recently been found in an ingenious one-piece riffle, for attachment to concentrating tables, which a New York firm has devised. Instead of being fixed on with tacks in the ordinary way, this new riffle has the tacks permanently attached so it can be more easily put on and taken off; moreover the heads of the tacks cannot be left projecting so as to interfere with the water currents. The makers of this G-O riffle, as it is called, claim to secure much better recoveries through its use, as it can be made much thinner (or lower) than a wooden riffle and can be more closely spaced, and, above all, it does not wear down so rapidly. Comparative tests made at the Miami and other mills in the Southwest substantiate these claims, and as it is now being tried on a large scale at several places more definite records should soon be available.

MEXICO.

The whole situation here is like a powder-magazine with the train laid, and only a match lacking to start an explosion such as we have never witnessed. Nobody knows anything about the local situation. All the newspapers that do not reflect the glory and justice, the *ley* and *libertad*, and all the other bosh of the new people, have been suppressed so that there is absolutely no news but what is favourable to the Constitutionalists. Not that anything has happened with respect to Villa, but seeing that Carranza has stopped calling himself head of the Constitutional force, it looks as if Villa had forced him to take the reins here merely temporarily pending further developments. Villa is going to have as big a say as Carranza, and perhaps bigger, and if he does not there will be trouble between the

two. The train service has been partly started again to Pachuca and Toluca, and also one or two trains have gone to the North, but as to when a man who sets out to get at El Paso, for example, will really reach there, and how much lighter in pocket he is likely to be when he does get there, no one can guess. The mines are just about to shut-down in Pachuca for want of supplies, for no effort is being made to get supplies from the coast. Of course, if all you have to do to provide yourself with money is to turn a printing-machine round, there is no necessity to put the business of the country on a revenue basis. No one may now leave without a passport signed by the military commandant of the city. There is no regulation of any kind. The people who have to obtain these passports have to wait in an immense crowd all day long. Zapata has definitely stood out from the Constitutionalist gang. He wanted to be recognized as the chief of the revolution, and that Carranza should sign his "plan of Ayala" together with all his officers and recognize Cuernavaca as headquarters, and cede Xochimilco to the Zapatistas, and many other demands such as these people, of course, could not consider. So they have been fighting again the same as ever, and Zapata has taken three out of the four pumping-stations at Xochimilco, so that there is hardly any water in the City.

LATER.

Here the position is as beclouded as ever. Villa holds the north with his forces, and Carranza holds part of the south, that part which is not in the hands of the Zapatistas and the ex-Federals in Oaxaca. If you buy a ticket for the North, you can only pay here as far as Zacatecas. When you get there, you pay again to the Villa people, who control all the country to the north, and, if the story is to be believed, have designs on the control of the south also. Anyway, it is pretty certain that Villa will not recognize Carranza as more than a temporary stopgap here; he asserts that he himself is as important to the revolution as Carranza, and he is certainly much more active and intelligent. Obregon, Carranza's right-hand man, has left suddenly for the North, just on the eve of the festivities here, and this is looked upon as a bad sign of the relationships between the rivals. There are the usual wild stories of all kinds of things that are likely to happen tomorrow, the 16th. I have made an arrangement just now to play tennis at the Reforma in the afternoon, which expresses my sentiments pretty well.



DISCUSSION

Ore.

The Editor :

Sir—I have been much interested in the lengthy discussion in your columns as to the meaning of the term 'ore,' although I had no thought of joining in until now. Your reply to the questions of Mr. J. H. Collins on page 37 and the editorial on pages 21 and 22 of your July issue, however, may excuse me for saying a few words on behalf of the ores themselves (they have always been more sinned against than sinning) and of those who study and use them. You state that "the man who can say what is ore, is a mining engineer," and add the obvious corollary that the mining engineer is the man most qualified to define an ore and that "we" are not concerned with the definitions of the geologist and mineralogist who only regard ores as "mineral aggregates."

It seems scarcely fair to add further burdens to the shoulders of the mining engineer. They are already cruelly over-laden and I venture to suggest that he would be wise, when attempting to define ore, to associate himself with the geologist, mineralogist, and assayer, who know what is in the ore, and with the ore-dresser, metallurgist, and chemist, who know what comes out of it. The mining engineer knows what he *receives* for the products. The other men know what they are and what they are *worth*.

I fear that your definition of a mining engineer would include too many members of the allied professions, but, if we can once agree what his duties really include and what he considers a 'metal' to be, there can be no objection to his employing a special definition of ore for his own use. It would be thoroughly understood, as you state, that others are not required to make use of it, but any definition which is accepted or even suggested ought to be capable of being understood and used by the mining engineer even though others may fail to grasp its meaning.

I have no intention of suggesting a definition nor shall I alter my present system or

rather want of system—which merely consists in calling a 'mineral aggregate' an ore when I think it advisable to do so—but I must deplore the use of any definition which makes such an aggregate liable to lose its name or await its christening time for market conditions to be suitable or for those who control its destinies to permit its exploitation to become remunerative.

If we take the most boiled-down definition, and therefore the one which ought to be the most easily used even if it be wrong, an 'ore' must be metalliferous and must be capable of yielding a metal under commercial methods of treatment, and we will admit (to save argument) that it ought to be capable of yielding the metal at a profit.

Mr. Collins' letter forms a most valuable contribution to the discussion, because I imagine that he wrote it to bring the matter to a head, but the lurid darkness cast upon the subject by the four lines which constitute your reply, are equally valuable as showing how difficult it is to make use of a definition which does not fit in with common usage or with the honorable intentions of its framers. You say "bauxite is an ore of aluminium" (which is of course correct) and you add "rock salt is not an ore of sodium." Rock salt contains a metal. It is treated both directly and indirectly, for the production of that metal. The metal is sold at a profit and is used as metal on a large commercial scale. I cannot imagine a more perfect example of an ore under any definition which you have approved or discussed in *The Mining Magazine* or which your contributors have suggested or (I believe) which could be suggested unless a definition be deliberately invented to exclude what the user prefers not to include.

I am quite satisfied to call the material 'rock salt' and not worry myself or anyone else as to whether it ought to be called an 'ore,' but I should like to know why you admit bauxite and exclude rock salt. I should also like to know why you call pyrite an ore of sulphur. I think most of us would wish to

do so, but I scarcely think it is covered by your suggested definition of ore. Pyrite is certainly metal-bearing but it is not necessarily 'metal-yielding,' which you indicate is one of the attributes of an ore in the words following your dictum that rock salt is not an ore but that pyrite is. If it is an ore because it yields sulphur and not because it is combined with a metal, we ought to include native sulphur. This is logical, but not possible, if an ore must be metal-bearing.

I fully appreciate the obstacles encountered by those who try to improve careless habits and I trust that what I have written may not be taken as intended in a carping spirit, although it is intentionally destructive. Had I not been writing to *The Mining Magazine*, I should probably have been much less blunt, but I know that you wish to hear the opinions—right or wrong—of those who are interested and that you prefer them to be definitely expressed. I only regret that I cannot offer any suggestions which may assist in evolving a fool-proof definition of ore, but I am personally in favour of having no definition at all. Definitions are often more hindrance than help and I would rather let a man call a thing an 'ore' when he believes it to be one than ask him to worry over a definition whose very explicitness might rob it of much of its utility. If he does not know whether it can justly be called an ore *in the circumstances*, he is incompetent and no definition will help him.

GEORGE T. HOLLOWAY.

London, August 4.

[Mr. Holloway's criticisms are helpful. Of course, the mining engineer knows what is in the ore as well as the "geologist, mineralogist, and assayer"; indeed, he knows the commercial value of the ingredients better than any one of them, for his appraisal of ore is based on economic facts. The assayer who tells him that the mineral contains so much lead at £19 per ton, so much zinc at £22, and so much copper at £65 per ton, may join with the geologist and mineralogist in adding the aggregate nominal value of the three metals in the mineral so as to reach an impressive figure, but the mining engineer, whose duty it is to ascertain whether the mineral can be exploited at a profit, that is, whether it is 'ore,' will know that the presence of three metals may hinder the separation of any one of them and may complicate the extraction to such an extent that the gross value on paper may either be reduced considerably or diminished to the vanishing point. We demur to the suggestion that the "geologist, mineralogist,

and assayer" know what the metallic products are worth, and that the mining engineer knows only what he receives from the sale of those products. That cannot be accepted for one moment.

As to our note to Mr. Collins's letter, we thank Mr. Holloway for correcting an obvious typographical blunder. The 'not' has been transposed. Rock-salt is an ore of sodium, but pyrite is not an ore of sulphur, when mined as a source of sulphuric acid, as is usually the case. Bauxite is an ore of aluminium; china-clay is not. If the exploitation of the rock-salt or of the bauxite is not economically advantageous, as a source of sodium and aluminium, respectively, then they are more properly called 'minerals.' When rock-salt is mentioned as 'ore' it should refer to the mineral as a commercial source, through caustic soda, of the metal sodium; when it is exploited as a condiment or preservative, it is not 'ore.' Chalcopyrite is an ore of copper when that metal is extracted from it profitably, but not an ore of iron unless it is worked for its iron content, which is not done, save as a secondary by-product. The difficulty is obvious: the definition of metal. In chemistry, a 'metal' is an element that forms a base by combination with oxygen. To the chemist, for example, silicon is not a metal, because it forms an acid with oxygen. Yet ferro-silicon is commonly called an alloy. Aluminium is a metal as extracted from bauxite, but aluminium in fire metallurgy is not regarded as a metal, because it plays its part there as the oxide, alumina, which may act as an acid or base, according to conditions. Americans talk about 'phosphorus ore,' meaning phosphoric iron ore, and 'phosphate rock,' meaning lime phosphate used as fertilizer. Apparently the subject bristles with anomalies, arising largely from the varying use of the term 'metal'; for example, 'road metal.'

But all these verbal wire entanglements present no real obstacle. The mining engineer need not be bluffed by the "geologist, mineralogist, and chemist." The test of 'ore' is not chemical but commercial. If the mass of mineral containing the metal or metals can be exploited to advantage, it forms the basis for a commercial enterprise, and is 'ore.' The 'metal' that comes within the immediate cognizance of the miner is a substance having a metallic lustre and recognized qualities that cause it to find a ready market for use in the arts. For instance, sodium is now used entirely as a chemical in the manufacture of other compounds; it might be used to fill an

iron pipe and employed as a highly efficient conductor of electricity. Then it would come within the customary meaning of 'metal.' The critics that fall back on usage as an argument against a closer definition of 'ore' are inconsistent when they refuse to recognize the well established meaning of 'metal' in the arts. Whether the chemist considers that silicon is as much a metal as iron, sulphur as much as spelter, is not to the point of the definition under discussion. In other words, Mr. Holloway draws a red herring across the trail, and we refuse to lose our way in the perplexities of his own science of chemistry. Our aim is to turn two misleading synonyms into two distinct terms, 'mineral' and 'ore.' We are trying to differentiate between the significance of these two, so that each may be an instrument of precision. The idea is that all ore is 'mineral,' but all mineral is not 'ore.' We want the commercial idea, which is essential to mining, to be emphasized. When the geologist, mineralogist, or chemist talks of 'mineral,' he means a part of the rocky exterior of this earth, interesting to him for scientific reasons, but not primarily on account of its advantageous yielding of a metal used in the arts. When he talks of 'ore,' he means something that is mined or may be mined, this year, next year, or in the millennium. When the mining engineer talks of 'ore,' he means mineral yielding a metal to be extracted by known processes as the final stage of an exploitation that viewed as a whole will be economically advantageous, and having economic value this exploitation must be completed at a given time and place, not in the Greek Kalends and not in the Hesperides. Thus we return to the definition of 'ore' as "rock from which metal can be extracted to economic advantage."—EDITOR.]

Long and Short Tons.

The Editor :

Sir—In an editorial in your issue of June, you refer to the confusion between the various kinds of ton, favouring that wretched Americanism, the short ton of 2000 pounds, the introduction of which into British gold-mining practice was brought about by those mine-managers from the United States who invaded Africa and West Australia about two decades ago, upon a campaign of cost reduction, bringing with them for that purpose their short little ton. I do not propose here to champion British weights and measures from a sentimental standpoint or because of their antiquity, for it must be admitted that in com-

parison to the metric system they are complicated; but they are established and understood, and to inflict the short ton of bastard growth upon those responsible for our official mining statistics is an abomination; the insignificant number of gold-mine officials who may save a few fractions of a second per day by the use of the 2000-lb. ton does not justify the introduction of such an ambiguity. In your editorial you remark that "in gold mining the short ton is universally used." Surely this is an unverified statement? In New Zealand and all the Australian States, the official mining statistics are returned and published on the statute ton basis (2240 pounds). In the Home Office 'Colonial and Foreign Statistics,' the statute ton is used for all minerals, but the metric ton is also appended for comparison with foreign countries. It may be stated that in your editorial you imply that the short ton only was used by managers of gold mines, but even with this amendment I do not agree.

I may state that I had the honour to compile the official statistics from the gold mines of West Australia for several years, and for the past eight years have compiled the New Zealand Government official mining statistics. In West Australia I never received a return from any mine on the short-ton basis; in New Zealand only two of the 63 working quartz mines use the short ton. The only British Government Mines Department using the short ton is that of South Africa, and possibly Canada. It may be asked, what is the inconvenience caused to British statisticians by the introduction of the short ton for gold-quartz mining output? I will furnish a few objections which I have personally experienced.

1. It now necessitates a prefix or definition every time the word 'ton' is used in an official statement.

2. The compiler of official statistics, for security, since the introduction of the short ton, is compelled to communicate with any person who furnishes a return not defining the ton used. This often occasions delay, as people are not over keen in furnishing returns to Government, for which they are not paid.

3. Comparison between the official returns from some British Dominions and States is frequently impossible for the same reason, without special computation. For instance, it is impossible to compare the tons raised per life lost in the coal and gold mines of South Africa, different tons being used for each mineral. Again, it is impossible to compare official statements into which tonnage enters

in the Government Mining Statistics of West Australia and South Africa respectively, as different tons are used in connection with gold mining. I respectfully suggest that before there is any more tampering with our weights and measures, attention be given to cases where there really is cause for improvement, such as, for instance, the American miners' inch (the U.S. unit) = 0.025 cubic feet of water per second, the New Zealand unit being the sluice-head = 1 cubic foot per second, likewise the U.S. gallon (of water) weighs 8.3216 lb., whereas the Imperial gallon weighs 10 lb. In both these examples American mining engineers have now an opportunity to reform, and thereby save time in their computations.

FRANK REED,

Inspecting Engineer, Mines Department,
New Zealand.

Wellington, July 29.

[The reports of mining companies nowadays use the short ton, though government publications have to conform to the legal unit. For good or ill, the short ton has persistently won its way among mining engineers throughout the world. Three years ago the firm of John Taylor & Sons, whose reverence for both law and custom is unimpeachable, found it desirable to adopt the short ton. Any further argument for or against the practice is futile. Nevertheless, as we said in the paragraph quoted by Mr. Reed, an anomaly has arisen owing to the discrepancy between the miner's and metal merchant's tons, and at present it appears to be a drawn game between the rival camps.—EDITOR.]

In Mexico.

The Editor :

Sir—A few days ago I received your letter of April 28, in which you mentioned that you were holding my magazines pending instructions. Please forward as usual to my old address. My agents there will find some means of forwarding the copies on to me.

The April number came to hand all right a few weeks ago. You cannot tell how pleased I was to get it, together with some letters and papers, the first mail I had in three months. The Constitutionals in Sonora, Sinaloa, and western Durango are now establishing a telegraph and mail service; it is very irregular still, but better than nothing. There has not been any mail service in this part of the country since September 1913.

Several mines are starting up work again in a small way. There are still great difficul-

ties in getting explosives and materials. The ordinary necessities of life are scarce and dear. Matches and candles are not to be had at any price. We have to make our own tallow dips and use the old flint, steel, and tinder to get a light. Certainly I do not envy our forefathers if that is what they had to put up with. To have your tallow dip blow out in a windy drift and then try and light it with a flint and steel, is by no means the easiest job I have come across in mining. Just for the fun of it try and light your after-dinner cigar with a cold chisel, a dry rag, and a chip off a Danish pebble.

E. L. SHERA.

Tominil, August 24.

Zinc Smelting.

The Editor :

Sir—Over 500,000 tons of Broken Hill zinc concentrate was shipped to Europe during 1913, all to be smelted in Belgium, Germany, and Holland, except for the comparatively small amount mentioned below. The mining industry at Broken Hill is practically at a standstill owing to the inability of the buyers to take delivery of the concentrate, and at the same time there is in England a marked shortage of spelter and zinc products due to the inadequate capacity of the zinc-smelting works.

The suggestion has frequently been made to erect further plant to smelt zinc ore, but the capital expenditure is large, although such outlay has proved highly remunerative to the continental companies. For treating zinc concentrate, like that from Broken Hill, in addition to making spelter, the works have to be arranged to condense sulphuric acid, to recover 'blue powder,' to separate metallic lead, and to treat argentiferous leady retort-residues. The older plants in Wales are not laid out to obtain these valuable by-products, and consequently cannot compete with the foreign smelter for such ores. The capital cost of the plant is obviously higher than is required for works where only calamine is handled, but while the supplies of calamine become less every year, there seems to be no end in sight of the less easily reduced zinc-blende.

The argentiferous leady retort-residues should be treated direct at the zinc works, because the tonnage is so large and the material so low-grade that freight and handling charges become important. The addition of further lead is requisite to collect the silver.

From 100 tons of Broken Hill zinc concentrate 36 to 40 tons of spelter and 'blue pow-

der' is obtainable, as well as 85 tons of strong acid, 1 to 5 tons of metallic lead, and 75 to 80 tons of retort residue. For smelting with the residue at least 35 tons of leady concentrate is desirable, but a larger quantity simplifies the recovery of the silver and lead contents. These figures vary with the grade of the concentrate and are only stated as an indication of the quantities.

The standing charges on a modern zinc-smelting plant are high, so that the best results are not obtained in a small works. The

treating a larger tonnage and the expenditure includes some provision for increased production in the future. The works were erected seven years ago; since then important improvements have been made in the art.

H. M. RIDGE.

London, September 28.

[We refer to this letter in our editorial columns. The 'blue powder,' which is used in cyanide-plants for precipitating the gold, is finely divided pure metal in the form of dust.

—EDITOR.]



INTERIOR OF A MODERN ZINC SMELTER.

treatment of 40,000 tons of zinc concentrate per annum is a convenient unit on which to base calculations. Apart from the price of the land, the outlay on such a plant in the United Kingdom will amount to approximately £450,000. This is equivalent to about £30 per ton of annual production of spelter. This calculation is confirmed by the figures of the zinc works at Seaton Carew, where during the year ended March 30 last 9870 tons of concentrate was distilled for 3461 tons of spelter. At this plant there is no provision for lead smelting. The capital outlay at Seaton Carew is equivalent to £36. 7s. per ton of spelter produced, but the works were designed for

The accompanying photograph was taken on the Continent and shows some zinc-distilling furnaces with two rows of retorts. In accordance with modern practice, the furnaces are built end-to-end and are comparatively small, each having 96 retorts. On the left, in the picture, three men are carrying a freshly annealed retort to the furnace. Next is a man preparing to draw residue, while the following two men are tapping metal from a condenser into the casting-ladle. At the adjoining furnace, charging has been completed and the attendant is examining the condensers. The metal extensions or 'prolongs' in which 'blue powder' is caught are in position.

PERSONAL.

THOMAS BREAKELL has returned from Siberia and Asia Minor.

R. W. BROCK has resigned as Canadian Deputy Minister of Mines to become head of the Mining School in the University of British Columbia.

F. O'D. BOURKE, manager of the Naraguta, has returned from Northern Nigeria.

J. W. BROUGH, a brother of the late Bennet H. Brough, has migrated from Belgium, and is now working in the office of the Press Censor.

GELASIO CAETANI is on his way from California to Italy.

VAL. E. DE CARTERET has returned from Russia.

J. PARKE CHANNING is recovering from the appendicitis operation.

W. R. H. CHAPPEL, of the firm of Chappel & Osborne, has been elected a director of Tekka, Limited.

J. G. CUNNINGHAM is still in Uruguay, but hopes to return soon.

F. LYNWOOD GARRISON has returned to Philadelphia from Alaska.

R. M. GEPPERT is returning to London from Siberia through San Francisco.

E. MACKAY HERIOT arrived in England after being detained five weeks at Clausthal.

LIONEL E. HILL has come from Japan to enrol in the army.

KARL HOFFMANN sailed for New York on October 7.

THEODORE J. HOOVER is expected from America.

J. POWER HUTCHINS has returned to Petrograd.

LUIS JACQUESSEN, manager of the Costa Rica mine, in Nicaragua, has joined his regiment in France.

EUGENE KENNEDY and W. P. LASS have formed a partnership and opened an office at Juneau, Alaska.

ROBERT A. KINZIE has resigned as manager of the Alaska Treadwell group of mines and opened an office at San Francisco.

GEORGE C. KLUG has made an examination of the Hercules mine, Tasmania.

H. H. LEWIS, smelter superintendent for the Union Minière, is home on vacation from Katanga.

FRANCIS CHURCH LINCOLN, lately engineer to the Bolivian Development & Exploitation Co., has been appointed head of the Mining School in Nevada University.

W. J. LORING sailed on September 26 from San Francisco to China.

V. F. STANLEY LOW has gone to Southern Cross, in Western Australia.

W. MCCAMERON is returning to South Africa.

HECTOR MACKILLIGIN has been appointed alternate assistant-manager of the Prestea mine, West Africa.

A. CAPPER MOORE has been re-elected president of the Victoria Chamber of Mines.

C. H. MUNRO is at a San Francisco hospital, recovering from an operation for appendicitis.

A. R. PHILLIPS is returning from Burma to Falmouth.

E. DAVID POPE has opened an office at Santiago, Chile.

J. HENRY RICKARD has returned from Naraguta, Northern Nigeria, to Newquay, Cornwall.

D. M. RIORDAN came on the U.S. warship *Tennessee* as special agent in charge of the \$4,500,000 sent for the relief of American refugees. He has returned to New York.

BERNARD H. SANDERS has returned from Northern Nigeria.

P. B. SCOTLAND, general superintendent for the Arizona Copper Co., is in London.

W. E. SIMPSON has gone to Cobalt.

S. A. R. SKERTCHLY is resident engineer for the Sakalava Proprietary Oil Fields of Madagascar.

E. A. SMITH has returned from Sinai.

H. STADLER is engaged in metallurgical research at the Royal School of Mines, South Kensington.

F. W. THOMAS, who recently retired from the secretaryship of the Dolcoath Mine, Limited, has been elected a director of the company in succession to the late Gilbert B. Pearce.

R. GRYLLS THOMAS, manager of the Hausa, is home from Nigeria.

E. H. VAUGHAN has returned from Portugal.

ARTHUR L. WALKER is returning from Japan to New York.

H. H. WEBB sailed on October 10 for New York.

MORTON WEBBER is at Porcupine, Ontario.

E. M. WESTON has been appointed underground manager for the Government Gold Mining Areas (Modderfontein).

A. S. WHEELER is in China.

H. C. WOOLMER has returned to Moscow.

ARTHUR YATES has been retained as a demonstrator in the Royal School of Mines.

R. B. YOUNG is here from South Africa.

THE ROLL OF HONOUR.

Members of the Mining Profession in Military Service.

- E. J. AVERY,
Duke of Cornwall's Light Infantry.
- CECIL F. BAKER,
Duke of Cornwall's Light Infantry.
- H. BERTRAM BATEMAN,
Royal Field Artillery.
- A. L. BELL,
23rd County of London.
- J. H. BENNETTS,
Ambulance Corps.
- J. A. BEVAN,
Royal Naval Division.
- J. P. BLANE,
King's Royal Rifle Corps.
- T. K. BREAKELL,
Duke of Cornwall's Light Infantry.
- C. M. CARROLL,
Public School Corps.
- ARTHUR J. CHIVERS,
Royal Naval Division.
- C. C. CLOUD,
Queen's Westminster.
- BRYAN COOKSON,
Army Service Corps.
- PHILIP CORDNER-JAMES,
Public School Corps.
- H. T. CURTIS,
28th Middlesex (Artists).
- F. DEVERELL,
Post-Office Rifles.
- ERNEST DICKSON,
Army Service Corps.
- G. F. ELLIS,
Cavalry, as Motor Driver.
- R. W. ELLIS,
11th Royal Fusiliers.
- A. M. FARQUHAR,
Scottish Horse.
- J. C. FARRANT,
Royal Naval Volunteers.
- ROWLAND C. FEILDING,
City of London Yeomanry.
- ALFRED FOX,
Public School Corps.
- A. S. FRASER,
Lovat Scouts.
- B. E. FRAYLING,
- C. E. FYSH,
Seaforth Highlanders.
- B. G. C. GARD'NER,
Public Schools Battalion, Middlesex.
- B. L. GARD'NER,
Public Schools Battalion, Middlesex.
- WALTER GARDNER,
Honourable Artillery Company.
- V. GARLAND,
23rd County of London.
- S. A. GEMMELL,
6th Highland Light Infantry.
- W. GRAHAM,
Cameron Highlanders.
- E. C. GRAVES,
Duke of Cornwall's Light Infantry.
- T. C. F. HALL,
Royal Garrison Artillery.
- L. C. HATCH,
Durham Light Infantry.
- W. M. HENDERSON-SCOTT,
Queen's Westminster.
- W. HENKEL,
11th Middlesex.
- L. C. HILL,
Public School Corps.
- LIONEL E. HILL,
Royal Naval Division.
- HENRY N. HOLLAND,
2nd King Edward's Horse.
- G. C. HOLLIS,
Unattached.
- WILLIAM HOPKINSON,
King's Royal Rifles.
- L. G. HUTCHINSON,
New Zealand Contingent.
- E. R. HUTT,
Electrical Engineer Corps.
- R. R. JEWELL,
2nd West Kent Yeomanry.
- H. A. JUDD,
2nd King Edward's Light Horse.
- J. W. LAKE,
23rd County of London.
- H. W. LAWS,
Motor Service R.F.C.
- LIONEL LINDSAY,
King's Royal Rifles.
- F. P. LONGMIRE,
5th Border.

- P. K. LUCKE,
Legion of Frontiersmen.
- R. K. McDERMOTT,
Seaforth Highlanders.
- P. H. McDOWALL,
2nd King Edward's Light Horse.
- A. MACGREGOR,
Royal Engineers.
- HAROLD MACANDREW, D.S.O.,
9th Lancers.
- H. P. MANTON,
Westminster Dragoons.
- E. SEABORN MARKS,
23rd County of London.
- E. S. MARSHALL,
Royal Fusiliers.
- G. W. T. MARSHALL,
Duke of Cornwall's Light Infantry.
- HAROLD D. MARTIN,
Honourable Artillery Company.
- A. H. MOREING,
4th London Howitzer, R.F.A.
- GODFREY E. MORGANS,
Royal Naval Division.
- S. J. NATHAN,
Honourable Artillery Company.
- W. W. NEVILLE,
Electrical Engineer Corps.
- E. F. NEWELL,
Queen's Westminster.
- K. C. NICHOLS,
Public School Corps.
- B. H. NICOLSON,
Motor Service, R.F.C.
- J. T. M. O'BEIRNE,
3rd Royal Warwickshire.
- J. A. O'BRIEN,
28th Middlesex (Artists).
- H. W. S. OUTRAM,
Electrical Engineer Corps.
- S. C. PARTRIDGE,
1st County of London Yeomanry.
- GEOFFREY R. PATON,
Public Schools Battalion, Middlesex.
- A. J. PETERSON,
2nd King Edward's Horse.
- C. H. PITT,
Imperial Light Horse.
- H. POMEROY, Jun.,
Liverpool.
- A. T. M. POORE,
Royal Irish Rifles.
- J. G. POOLE,
Duke of Cornwall's Light Infantry.
- J. D. RAMSAY,
Scottish Horse.
- W. RANCE, Junr.,
Public School Corps.
- A. B. REECE,
Royal Garrison Artillery.
- R. W. RICE,
Royal Garrison Artillery.
- E. J. RICHES,
Honourable Artillery Company.
- R. W. ROBINSON,
5th Inniskilling Fusiliers.
- H. R. RUGGLES-BRISE,
Natal Light Horse.
- W. T. SAUNDERS,
West Kent Yeomanry.
- H. C. SCHACHT,
28th Middlesex (Artists).
- G. SCHACK-SOMMER,
Russian Army.
- THOMAS SCOTT,
Duke of Cornwall's Light Infantry.
- J. D. SHEPHERD,
Duke of Cornwall Light Infantry.
- R. O. SIMON,
Public School Corps.
- GEO. SIMPSON, Junr.,
Public School Corps.
- RALPH STOKES,
Royal Engineers.
- C. B. C. STOREY,
Lancashire Fusiliers.
- L. A. E. SWINNEY,
28th Middlesex (Artists).
- H. TATHAM,
Electrical Engineer Corps.
- D. M. TOMLINSON,
2nd King Edward's Horse.
- DEREK TREWARTHA-JAMES,
Royal Berks.
- H. L. TWITE,
3rd Royal Field Artillery.
- R. P. WILD,
Unattached.
- A. B. WILLIS,
Royal Naval Reserve.
- A. E. YOUNG,
Public School Corps.

GEOLOGY APPLIED TO MINING. V.

By T. A. RICKARD.

* ONE of the simplest and most effective applications of geology to mining is illustrated by the story of the beach-placers of Nome. To dig gold from the sea-beach is an ideal method of making money. I saw a hundred men doing this in the summer of 1908 at Nome, which is in the far north-western corner of the American continent looking across Bering Sea to Asia. Nine years earlier, in June 1899, a soldier had been the first to detect particles of gold in the sand near high-water mark. In less than two months 2000 men had extracted over \$1,000,000 worth of gold from the beach. Altogether \$5,000,000 has been won from this marine ore deposit.

Nome is on the outer edge of a coastal plain that slopes southward imperceptibly from the hills of the Seward hinterland. The distance across the plain from the hills to the sea is 4 miles. The hills enclose the plain in a crescent curve that ends eastward at Cape Nome and westward at Cape Rodney, the coast-line stretching between them for 30 miles. This coastal plain is blanketed by the 'tundra,' a Russian word of Siberian origin given to the moss-covered plains that characterize the sub-Arctic wilderness. The monotonous surface is broken by meandering streams and by extensive terraces; these terraces are escarpments of gravel parallel to the coast. We have here all the evidence of repeated elevation of the land, with the formation of a series of raised beaches, remarkable for the fact that they

contain enough gold to constitute ore deposits.

Let us review the evidence on which this geological diagnosis was finally established. First I shall take you back to the beach at Nome and show you the miners digging gold by the simplest of methods. As the shore is a Government reservation, no location of claims is permitted. Each man holds a small



THE TUNDRA.

PHOTOGRAPH BY COURTESY OF UNITED STATES GEOLOGICAL SURVEY.

patch of ground only as long as he is at work. This possessory right is recognized by his comrades. The prospector tests the sand by washing it in a pan. If the result indicates the presence of gold, he digs a hole. Except after a storm, when the waves have re-concentrated the particles of gold, it is necessary to remove the top sand and shingle. Thus I saw a man, shovel in hand, scrape the sand to one side and dig a small hole into the red layer underneath. It is red because of garnet, which, being heavy, is associated with the gold. Hence the term 'ruby sand.' Shovelling 20 pounds of this material into his

*The last of a series of five lectures delivered at Harvard University in May 1913, and at the Royal School of Mines in January 1914.

pan, the miner walks to the edge of the sea, digs another hole, which, becoming filled by the incoming wave, serves as a basin wherein he washes his sample. He obtains several 'colours' or specks of gold. Thereupon he erects his simple machine for extracting the precious metal. This is a box with a false bottom of coarse wire-screen or perforated tin-plate, which serves to separate the coarse sand from the finer stuff containing the particles of gold. The box or 'hopper' is supported on rockers; hence the other name, 'cradle,' whereby a rocking motion is imparted, in order to hasten the sifting process. From the top of the machine, which is tilted forward so as to form an inclined plane, the sand runs along a sluice-box or launder, the bottom of which is lined with riffles, to break the current, and with plates of amalgamated copper, to arrest the gold. In the early days all the silver dollars, the copper sheathing on boats, and the coffee-urns in the restaurants were requisitioned by the diggers, who needed the metal to make their amalgamating devices.*

The geological section of this marine placer is as follows: The uppermost layer is composed of sand and shingle, in which quartz and schist can be recognized. At the limit of tide a red band of garnetiferous sand appears underneath, darkened by particles of magnetite. At the foot of the tundra, that is, at the upper edge of the beach, a layer of clay can be detected, dipping under the garnetiferous sand. This clay serves as a false bottom or impervious layer on which the gold, garnet, and magnetite have been concentrated. Along the productive portion of the beach, as I saw it, the clay was from 4 to 7 feet below the surface; the fringe of red sand, representing the marine concentrate, was from 6 inches to 2 feet thick, and from 3 feet to 4 feet wide, under an overburden of shingle from 3 to 6 feet deep. The dip is to the sea at an angle of about 5°, as illustrated in the accompanying sketches.

The question arises: whence came the gold found in this beach? The metal is in minute particles, the average being measured by the fact that 75 specks are worth 1 cent, valuing the gold at \$14 per ounce. The largest piece that has been found weighed about 1 penny-weight. The gold is flaky, such as is not un-

usual in schistose lodes. In the sand are bits of quartz and schist that suggest the original matrix. The gravel under the tundra has a similar composition. The gold obviously was derived from the washing of the seaward edge of the coastal plain, the waves concentrating the heaviest particles, of sand, garnet, and magnetite, along the tidal margin. But whence came the detritus of the coastal plain? We have not far to look, for the hills inland are composed of schist in which small veins of gold-bearing quartz are plentiful. That schist is undergoing erosion. The débris due to erosion today, as formerly, is being carried from the inland valley by the running stream, which, swift or slow, in summer or in winter, bears its burden seaward, to be deposited in the flats of a delta that has grown to the dimensions of a coastal plain. The tide does the rest. We judge the past by the present; from the operations of today we infer those of a geological yesterday. At Nome we have an example, important because it has economic value as well as scientific interest, of a geological cycle, beginning with erosion and denudation, and ending with deposition and concentration.

This simple geological reasoning was applied effectively at an early date in local history. Not only did A. H. Brooks, in charge of a geological reconnaissance for the Survey, in 1900, recognize the salient facts,* but he suggested the probability that old beach-placers similar, so he said, to those that had been found in Oregon, might be discovered. He saw the evidence of a recent elevation of the Seward peninsula, and drew attention to terraces that looked like former shore-lines. From this he drew the logical conclusion that raised beaches, similar in origin to the one from which gold was then being won at Nome, might be found. Here we have the real test of science: the ability to predict. For Mr. Brooks was entirely correct. At least two rich and well defined beach-placers of a former geological time have been traced for several miles, while disconnected portions of other gold-bearing beaches have been uncovered by prospectors. From one of these, the Third Beach, not less than \$17,500,000 was extracted in a decade.

The placer on the shore of Bering Sea is a fringe at the tidal limit. It has been formed by wave action. The surf is the concentrator. After a big storm the shelving sand is freshly

*One reason why the beach is the scene of recurrent operations is the incomplete character of the gold extraction. Apart from the crudity of the methods employed, the difficulty of catching the gold is increased by the presence of shell-oil. This hinders amalgamation, that is, the formation of an amalgam or alloy of gold and mercury. On one of the beach lines, known as the Intermediate, the oil in the sand was so plentiful and gave so much trouble that the deposit was called the Clam-Shell beach.

* 'Reconnaissances in the Cape Nome and Norton Bay regions, Alaska, in 1909.' By A. H. Brooks, G. B. Richardson, and A. J. Collier. Special Report U. S. Geological Survey. Published in 1901.

enriched, a fact so well known that rough weather is followed by an increase in the number of diggers on the beach. The tides, in their ebb and flow, wash the edge of the coastal plain, which is bounded on its seaward

board ship, the Russian controllers arousing the bitter antagonism of the other members of the party. The enterprise was as good an example of a geological theory divorced from facts as the actual expansion of placer mining near Nome was an illustration of sound reasoning from careful observation.

The beach-placer does not extend under the sea; it is, as we have seen, confined to a narrow strip along the shore at high tide. It is a concentration of gravel washed from the edge of the coastal plain, which in turn is an alluvial fan or delta created by deposition of the detritus brought down from the highlands northward.

There the prevailing rock is chloritic mica schist, with occasional beds of limestone, all seamed with small veins of quartz containing gold. No veins large enough or rich enough to be mined have, as



MINING ON THE BEACH AT NOME IN AUGUST 1908.

face by an escarpment from 10 to 20 feet high. Each spring tide, aided by a southern wind, encroaches upon this face of gravel, capped by moss, and concentrates the gold upon the beach, which is from 50 to 75 yards wide. When thus set in motion by the waves, and by the subsequent washing of the shore, the particles of gold tend to sink through the shifting sand until they rest upon an impervious layer or flat disc of clay. There they are collected, with the garnet and magnetite.

At one time it was imagined that the deposit of gold-bearing sand extended under Bering Sea and across to Siberia, a distance of 175 miles. An expedition, under Russian guidance, and financed by an Anglo-American syndicate, was actually despatched in 1900 on the *Sonoma* to find the other end of the placer on the opposite continental coast. I was asked to go, but declined. A landing was effected on the Anadyr coast, but no gold was found. This wild-goose chase came to an inglorious end by reason of gun-play on



WASHING BEACH-GRAVEL FOR GOLD AT NOME IN AUGUST 1908.

yet, been found, but from the multitude of small veins the natural agencies of erosion have collected enough gold to form rich alluvial deposits in creeks, the names of which to the northern miner are now synonymous with wealth. I may mention Anvil, Dexter, and Glacier creeks, from which millions of dollars have been won. The gold from the country-

rock and from the creek deposits has been transported seaward, with variable rapidity, according to the flow of water in the streams. After a period of sedimentation, an elevation of the land has ensued, the sea has withdrawn, and a crescent coastal plain has arisen, and thus by the later re-concentrating action of the waves has a beach-placer been formed.

When the true character of the beach-placer was recognized, it had already been noted, by the geologists of the Survey, that the surface of the plain, between the sea and the hills, is traversed by undulations or benches, suggesting the worn edges of former escarpments that might have marked an earlier shore. Evidence was plentiful to indicate that the region had undergone gradual elevation during recent geological time. The existence of well marked terraces containing marine shells up to an altitude several hundred feet above the present sea-level, was conclusive testimony. A long period of erosion in post-Eocene time had reduced the Seaward peninsula to a 'peneplain,' or base level of erosion, and this was followed by intermittent periods of elevation, recorded in the series of benches to which I have referred. Since 1900 the coast near Nome has been raised $4\frac{1}{2}$ feet. I am reporting the evidence as given to me in 1908. Several men testified to me that they had camped on the beach close to the sea on spots now well above the highest tide. The piles of the old Alaska Commercial dock were 20 to 30 feet out in the sea in 1900; now the tide seldom comes so far. The Solomon river runs more rapidly near its mouth than four or five years ago, so that scows that formerly went as far as Lane's Landing, half a mile from the mouth of the river, are now unable to do so. This is plain testimony to a simple geologic fact. Other evidence, more comprehensive, is afforded by the course of the Nome and Snake rivers; by the fact that the former bed of the Solomon river, at 8 miles from the sea, is 45 feet below present low tide; also by the finding of peat and tundra at 80 to 112 feet below the existing surface. These facts all point to a former subsidence followed by an elevatory movement, which is still in progress.

From the known we argue to the unknown. If the sea today washes and concentrates the gravel exposed at the edge of the coastal plain, then similar wave-action at other periods may have formed similar beach-placers. Where are they? If the gold is concentrated at the foot of the existing coastal escarpment, then the beach-placer of a by-gone

day is likely to be found under the face of a former escarpment. Such an escarpment would be indicated by a terrace crossing the plain. If eroded, it would now appear as an undulation parallel to the coast. Mr. Brooks told the prospectors "to examine carefully the Seward side of the different escarpments marking the limit of the terraces. These bluffs are likely to mark an old sea-beach."

Only half a mile inland from the beach at Nome is a steep moss-covered bank rising 10 to 30 feet above the plain and running parallel to the shore. This suggested a marginal escarpment not only by its shape, but because it topped a deposit of rounded pebbles and quartz sand containing water-worn fragments of sea-shells. In 1903 the prospectors sank their holes on the seaward slope of this mound and found gold. It was the ancient beach placer of Mr. Brooks' scientific imagination. The same line of beach was traced to Hastings creek, 10 miles east of Nome, where a beach about 40 feet above the sea gave the necessary clue. The garnetiferous sand containing the gold was found at a depth of 8 to 12 feet below the present surface, and only a quarter of a mile from tide-water. This beach deposit has been traced to the Snake river, which for several miles runs parallel to the present beach, and appears in this part of its course to mark the line of an old lagoon. The same beach deposit is supposed to cross Jess creek, enriching it near the sea. Thus the ancient beach-placer has been traced for about 20 miles altogether. In many places it was mined most profitably, the total yield being fully \$2,500,000. It remains to state that the deposit was found to lie at a level 37 feet above mean tide.

Other deposits of a similar kind, but less extensive, were found by exploratory work across the coastal plain, but it was not until the end of 1904 that the richest of all the beach placers was discovered. This one, famous now as the Third Beach, cannot be credited directly to geologic inference, as was the Second, but the prospecting precedent to the recognition of this curious ore deposit was undoubtedly stimulated by the knowledge current among the diggers on the subject, as explained by the geologist. While at Nome I obtained the story of the Third Beach discovery from the pioneers.*

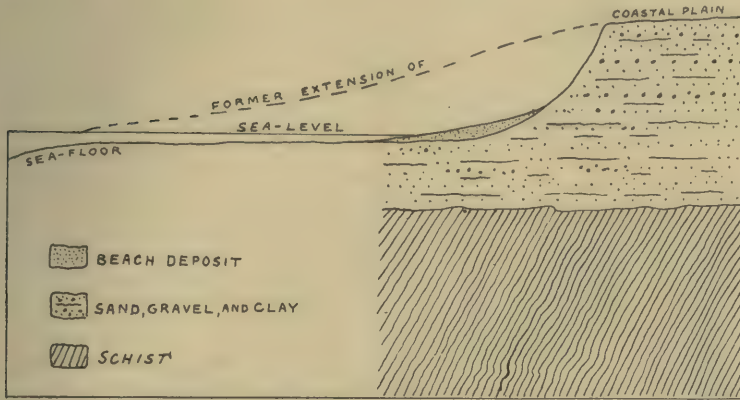
Toward the end of 1904, a miner named J. C. Brown was prospecting for the Moonlight channel on his claim, called the Railroad, be-

*See also 'Gold Mining on Seward Peninsula.' By F. H. Moffit. Bull. U.S.G.S. No. 284. Published in 1906.

cause it was at a place where the Seward peninsula railroad crosses Little creek. This Moonlight channel was an old creek-bed, now covered by a later deposit of gravel, and by the moss. At a depth of 40 feet, on September 19, Brown "struck rich pay," that is, he cut into gravel yielding gold at the rate of \$500 per pan—a pan holding 20 pounds of

the terms of their lease the Swedes were permitted to work only 8 men, including the cook: that is, one of the 8 men had to do the cooking, so that only 7 miners could work. The lease expired on June 1. The discovery was made 6 months after Brown's, that is, at the end of March, so they had only 60 days to dig a fortune. They hustled. They paid

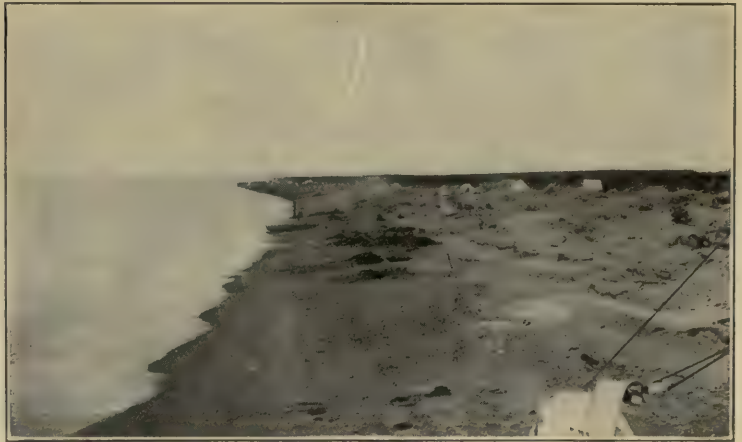
their men \$1 per hour and board. As soon as one worker was exhausted his place was taken by another. Everything was done in feverish haste. Meanwhile the heap of golden gravel was being accumulated at surface, to be washed in mid-summer. It was not a big dump, only about 6000 cars of 40 pans each, or 240 tons, but it was worth \$19 per pan. These three men in the 60 days took out \$750,000, of which 60% was theirs. The



SECTION OF BEACH PLACER

After A. H. Brooks

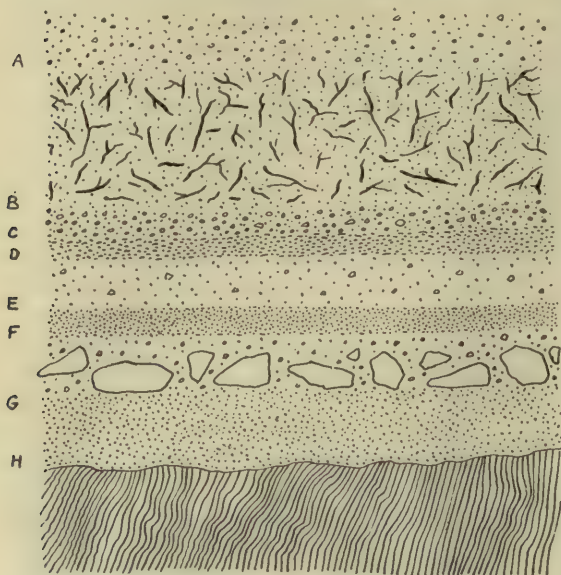
gravel. The news of the find caused great excitement locally and induced others to sink shafts nearby. This led to fresh discoveries along the same deposit. Jafet Lindeberg, one of the most famous of the pioneers, had bought several claims near Brown's claim in 1902 and 1903 for the Pioneer Company, and had extracted some gold, but nothing remarkable. This ground was known as the Portland bench. Lindeberg had let it on tribute—what are called 'lays' in Alaska—giving each of two parties of three men a strip 250 feet wide, so that the two leases extended 500 feet across the Portland Bench claim. Three Scandinavians, named Anderson, Peterson, and Johnson had sunk 5 holes to bedrock, at about 45 feet, and had found nothing. The sixth hole, or shaft, struck wonderful 'pay'; in places the bedrock was covered by half an inch of sediment that was almost pure gold. One pan yielded \$5170, which means that about one third of the material was gold. By



THE BEACH AT NOME IN 1900

other party of three men extracted \$250,000. This alluvial deposit was soon recognized as a beach concentration. It resembled the two previously exploited nearer the sea. Hence the miners inferred that the strike of it would be parallel to the present coast. The elevation above tide-water was found to be 68 feet, which is 31 feet higher than the Second beach. It was calculated that the same contour line running east and west would give the strike of the beach concentra-

tion, and it was assumed that the deposit would be limited by the action of the surf to a strip 100 to 150 feet wide. Actual work has proved these early inferences to be fairly correct. From Little creek to McDonald creek the Third beach follows a nearly straight line, allowing for local irregularities due to the little promontories that caused the beach to project forward. The regularity of the strike is suggested by the story told of Lindeberg, who, in order to locate claims correctly without attracting attention, laid out the course of the deposit across the tundra under guise of surveying a telephone line to Port



SECTION OF THIRD BEACH NEAR NO. 2 SHAFT OF THE
HAPPY NEW YEAR MINE.

- A-B 2 to 3 feet of old tundra.
- B-C Iron-stained pebbles.
- C-D Grey micaceous sand.
- D-E Sand, with pebbles of white quartz.
- E-F The ruby sand, containing gold.
- F-G Boulders of schist and limestone.
- G-H Two feet of fine grey quicksand.
- Below H Schist bedrock.

Safety. To indicate the richness of the deposit, it is worth while to tell you that in the Alta claim, where the beach lies on a false bottom of sand three feet above the true bedrock, the sand was so rich that the men, who had to kneel in the low stopes when at work, would sit at dinner in the boarding-house with their trouser-knees bespangled with gold. Miners returning from work and walking in their rubber boots over the snow would leave a trail that showed gold. Details such as these will help, I trust, to bring into relief the reality of an ore deposit that had a romantic as well as a scientific interest.

I give you a section of the Third Beach as sketched by me in the Happy New Year mine. The section covers a height of 14 feet. Under the usual coarse gravel of the present coastal plain lies the old moss. The roots and fibres lie buried in the grey clay in which it grew. Then layers of pebbles, micaceous sand, and gravel intervene, before the 'ruby sand' of the former beach deposit is reached. A handful of it is examined and gold can be detected. Underneath come boulders consisting of rounded fragments of the country-rocks that formerly enclosed the veins from which the gold was derived. This lies on grey quicksand, which in turn rests upon bedrock: a typical schist. The boulders under the golden concentrate are large. Some of them weigh as much as 8 to 10 tons apiece; they are surf-worn. More commonly the gold-bearing layer or 'pay-streak,' as it is erroneously labelled by the miners, lies on bedrock or on a false bottom of clay.

Here we have a fossil placer, covered and preserved from a by-gone day. It differs from that which we have seen on the Nome beach only in so far as it has been covered by later pages of the geologic record. It is preserved within those pages like a dried flower in an old album, to remind us of the circumstances under which it was gathered.

You have now seen a cross-section of the Third beach and are acquainted with its geologic past. It remains to connect this scientific diagnosis with practical mining, that is, the winning of money. By practical I do not mean, as some people mean, an apology for ignorance or rule-of-thumb, but the putting into practice of that sublimated common sense we call science. The mine that we shall take as an illustration is the Happy New Year, which, with its neighbours, both east and west, is shown in plan herewith. Owing to the necessities of space, I have drawn the continuation of the series of elongated workings in two parts one under the other. Beginning with the Otter No. 9 and Jupiter workings, you will see that these are only indicated in outline, as they were excavated in the summer of 1907 and the ensuing winter, before my visit. The method of mining is 'drifting,' that is, underground excavation by means of shafts, cross-cuts and drifts, predominantly the last. A shaft is sunk to bedrock, then a cross-cut is extended to the deposit itself, which is traced by means of a main drift, from which short gangways are



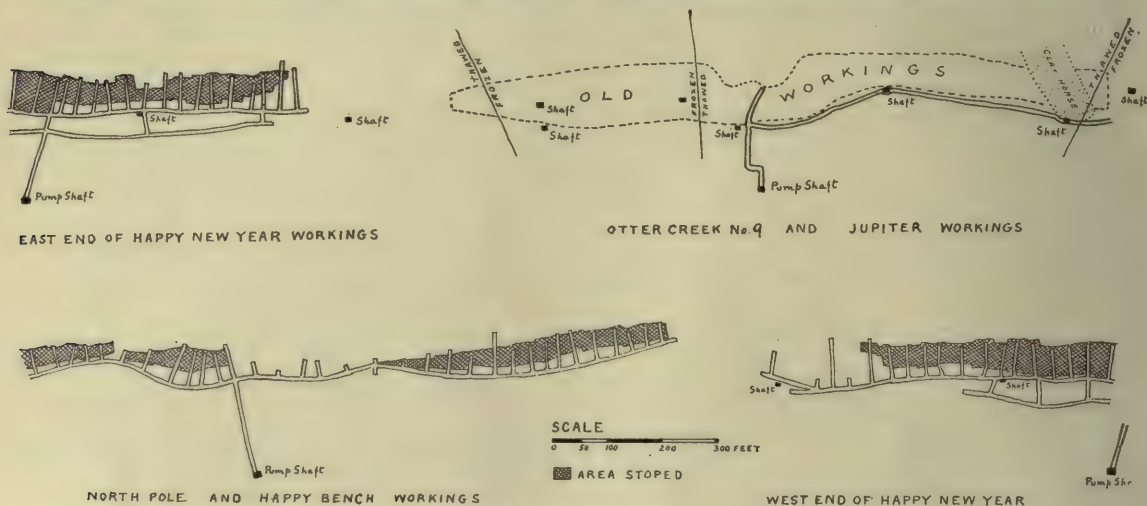
SKETCH OF THE BEACH PLACER OF NOME.



run across the width of profitable gravel. The main drift in an ordinary alluvial mine is run along the centre of the channel, but in the case of a beach deposit it is run along the lower or seaward edge, so as to facilitate tramming. Mining on the Third beach is distinctively 'drifting' in ground naturally frozen, by thawing and excavating the gravel as described in my preceding lecture. As regards the operations in such a mine as the Happy New Year, the first shaft is sunk to a depth of about 70 feet, or to 10 feet below bedrock, so as to make a 'sump' or well. This shaft is placed south of the beach deposit, at a distance of 150 feet from the ground to be stoped, so as to ensure its safety, in case of a settlement of the ground after the deposit has been

the roof of the stopes are shot-down so as to ease the ground. The barren gravel above the 'pay,' or gold-bearing layer, is shovelled into the old stopes.

From the plan of the workings you will see that the ground excavated averages about 75 feet in width. The deposit is more continuous than appears, for the blank spaces on the map are partly due to anxiety not to interfere with the safety of the workings by breaking into ground that, while relatively poor, is excessively wet, owing to having been thawed naturally. Several real blanks, however, do exist on the Third Beach. These have been tested unprofitably. Let me, however, quote some of the richer patches. From the Portland Bench to the Bon Voyage claim the average yield



PLAN OF PART OF THE WORKINGS ON THE THIRD BEACH. UPPER PORTION IS CONTINUATION OF THE LOWER.

mined. This shaft is intended for pumping and development. From it a cross-cut is driven to the south edge of the beach deposit; then a main gangway is run east and west along the lower or southern boundary of the gold-bearing gravel to the end-lines of the property. The main drift is timbered with regular sets, 5 feet apart, supplemented by lagging 2 by 6 inches, and 5 feet long. Then cross-cuts are extended north at intervals of 35 feet to the upper limit of the deposit. These also must be timbered, for the ground is heavy. Working shafts are then sunk along the lower or southern limit of the deposit at intervals ranging from 400 to 800 feet. Stopping is started from the upper or northern end of the cross-cuts so as to remove the ground while retreating to the main gangway. The timbers employed temporarily to sustain

was not less than \$1000 per running foot of beach deposit for a width of 40 to 80 feet, and a mean depth of 3 feet. From the Bon Voyage eastward to McDonald creek the average yield was about \$250 per running foot, for 30 to 75 feet wide, and 3 feet deep. The finest record is that of the May Fraction, in which claim \$330,000 was taken from a strip 110 feet long, 25 feet at its maximum width, tapering to 5 feet, and 3 feet deep. This is equal to \$3000 per running foot or about \$25 per cubic yard. The richest part of the deposit in this particular locality was thin; the gold was concentrated in the cavities within the first inch or two of the soft bedrock and in the inch of gravel immediately overlying, so that, as a miner expressed it, it looked as if someone had "spilled a poke," a poke being the small bag of moose-skin in which the 'sour-

doughs' or veterans of the North carry their gold. It is the digger's purse. Here is a poke filled with the 'pay-dirt' given to me by Jafet Lindeberg when I visited his workings on the Second Beach, near Penny river, on August 29, 1908. 'A pig in a poke' is a synonym for a poor bargain; gold in a poke is the emblem of northern affluence. In the Three Star claim the beach yielded \$3000 per running foot for 225 feet. The width averaged 80 feet, but the richest part was only 25 feet wide. The Nome miner says that good ground on the Third Beach averaged 10 cents per pan, which, at 150 pans per cubic yard is equal to \$15 per cubic yard. That is, for the average depth of 3 feet, or 1 yard, the yield was \$10 to \$20 per square yard.

This old beach had a gentle slope: from the seaward edge the rise is 1 in 12 to about the centre of the deposit, where it becomes steeper, averaging 1 in 10 landward. In the slight bend thus formed is found the richest sand.

It remains to mention the Intermediate Beach. We have thus the Present, Second, Intermediate, and Third Beaches, not to mention fragmentary and subordinate patches of other and similar deposits. The Present Beach is at the limit of tide. The Second is 37 feet higher and half a mile inland; it lies on a false bottom. The Intermediate is $1\frac{1}{2}$ miles inland, and is only 22 feet above sea-level, but it lies on bedrock. The Third is about 3 miles inland, and is 68 feet above sea-level: it lies on bedrock or near it. From the Third Beach the bedrock rises more steeply. The whole coastal plain is really one big alluvial deposit 9 miles long and about $3\frac{1}{2}$ miles across. All of the gravel is gold-bearing, to a variable degree, the richest portions being the beach concentrations, and next to them the creek-beds, both the former channels and those of today. To these may be added the estuarine deposits of the Snake and Nome rivers. How much of the plain can be mined must depend first on its gold-contents, to be ascertained by drilling or shaft-sinking, and, secondly, upon the cost of mining. An alluvial deposit does not become the subject of intelligent mining until it has been proved that the exploitation of it will yield dividends.

The gold-bearing sand is shovelled into cars, of 10 cubic feet capacity; these, on being hoisted to surface, are emptied into bins holding 150 to 200 cars, or enough for one shift of washing. The gravel, at a rate of 20 to 25 cars per hour, is emptied into the sluice-boxes, lined with pole riffles, followed by cocoa-nut matting protected by 4-mesh wire-screen.

The collection of the gold, therefore, is a method of concentration by gravity, hastened by the action of water, as in the case of the original deposit.

So our quest is ended. We stand on the lower slope of the Seward hinterland, and look across the coastal plain to the retreating waters of Bering Sea. The sombre tundra clothes the flat landscape with a sobriety strangely unlike the glitter of the golden treasure found underneath its ancient blanket of moss, and in glaring contrast to the feverish scramble that for a time made Nome a saloon, a restaurant, a brothel, and a casino. The near line of shaft-houses crossing the plain, east and west, marks the strike of the Third Beach. Other shaft-houses and workings dot the tundra, here and there, but they are insignificant interruptions in its insistent monotony. A dip in the surface hides the town of Nome, but a moving wreath of smoke bespeaks the engine on the little railway, which constitutes man's most significant conquest over this northern wilderness. The wind blows cold from the Arctic, no bird sings, no flower grows, we are on the edge of creation, and before us lies the evidence of the changes through which the earth has passed, and is forever passing. Deeply buried under the tundra are the sand, the shells, and the drift-word of a former shore, on which the tides ebbed and flowed as they do today on the beach at Nome. In their ebb and flow they washed the rim of gravel and loosened the gold brought from inland by the rivers. That gold was concentrated by the sea in its withdrawal from the slowly emerging land; and over the concentration was spread the silt and sand borne seaward by the river. This tribute from the hills was spread fan-like over a treasure that was to be hoarded until some strenuous Scandinavian dug into it with persistent pick. And so the cycle may seem at an end, but it is not so. We have simply punctuated the geologic story. It, like a Chinese play, is a continuous performance. We have only seen a small part of the natural drama. More is to follow.

"For we are ancients of the earth,
And in the morning of the times."

REPRINTS.—The foregoing five lectures will be re-printed in a pamphlet (Price: 2s.) for the use of students and others desiring to have them assembled in convenient form.

SIBERIAN CURIOSITIES

Gold-bearing dikes. Antiquities. A strange story.

By H. G. NICHOLS.

AT Bereyosovsk, in the Middle Urals, I saw a series of gold-bearing quartz veins, having a uniform length of 40 ft., which have been developed to a depth of 350 ft. These veins are the fillings of transverse fissures in dikes that extend through the country for several miles and which are 40 ft. wide. The dikes consist of beresite, which is an exceptional aggregate, according to Kemp, of quartz and muscovite. They occur in a chlorite schist, and roughly conform to the schistosity; the contact is irregular. The general appearance is as shown by the sketch (Fig. 1). In rare instances the fissuring extends through

formed and has installed electrically-driven turbine-pumps; by which 5,000,000 gallons of water per 24 hours is pumped from the mine.

The ore averages about \$9 per ton, and a 250-ton plant consisting of Chilean mills, a blanket plant, by which 32 c. per ton is extracted, and a cyanide percolation plant, effects a total extraction of 81%.

Visible gold is often found in these deposits, which are characterized also by the presence of a rare mineral going by the name of patrinite, having the formula $(2 \text{ PbS} + \text{Cu}_2\text{S}) + \text{Bi}_2\text{S}_3$.

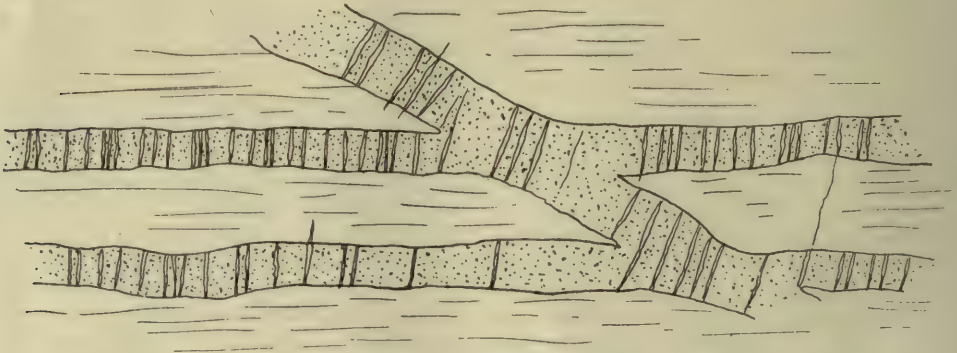


FIG. 1. GOLD-BEARING BERESITE DIKES IN SCHIST.

the intervening country between two branches of the dike. The veins are from 3 to 10 inches wide and are generally nearly vertical; they cut across the beresite almost at right angles to its strike. The gold is associated with pyrite, and the surrounding porphyry where it contains iron also carries some gold and is mined together with the quartz. The richest ore was found at about 150 ft. from the surface, but the deepest shaft is down 350 ft., and the veins persist to this level, at least. Generally two or three veins are sufficiently close together to be worked in one drift (or cross-cut from the main adit driven along the strike of the dike).

The mines were originally worked by the Government to an inconsiderable depth, but in recent years a private company has been

Further west and right in the centre of Asia, where even now the Russians are but slowly displacing the survivors of the wandering Tartar population, evidence exists of an age of mining well deserving a place among the most ancient traditions of the industry. In the stone and bronze period this country, situated along the upper reaches of the Yenisei river, was inhabited by a people of whom many relics have been found in recent years.

Mines are here being worked on several contact deposits between the limestone and an eruptive rock. From the workings of these mines connections have been made in several instances with ancient excavations that sometimes extend to a depth of 100 ft. below the surface. From these old workings the ancients obtained copper ore, and many old pits dug



FIG. 3. CARVINGS ON ROCK.

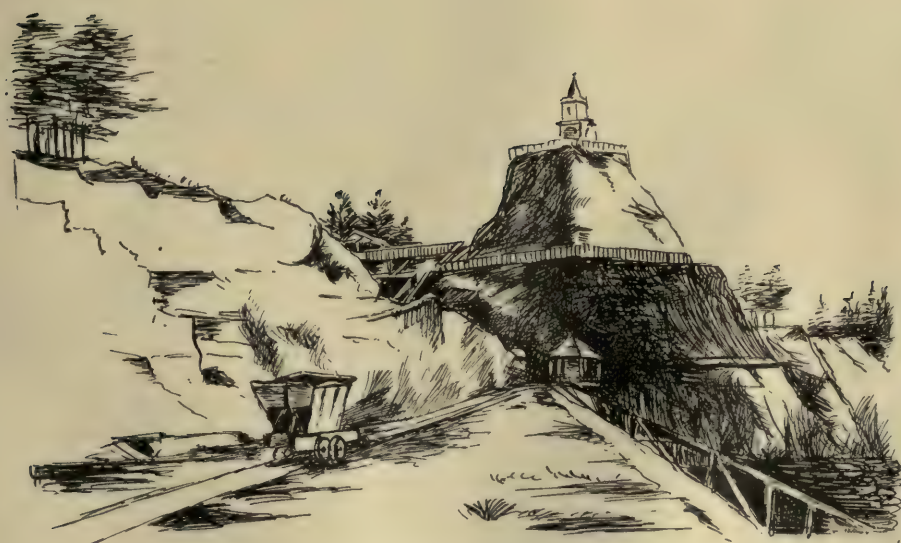


FIG. 4. THE CHAPEL OF GOROBLAGODAT.

by them have been cleaned out, showing that these workers of almost pre-historic time knew enough to prospect along the contacts in their search for the very same deposits that are still being exploited in just the same way.

The burial places of this people, locally called *koorghans*, are scattered all over the wide valleys. They are mounds, sometimes 75 ft. across; surrounded by slabs and pillars of rock on which, as well as on many outcrops of rock and monumental stones, inscriptions and representations of animals have been cut. These bear signs of undoubted antiquity. Some of the mounds have been excavated, and, in addition to human remains, a great variety of copper and stone implements and ornaments have been collected, bearing an undoubted resemblance to some of the draw-



FIG. 2. ANCIENT ORNAMENT.

ings on the rocks. An example of this may be seen by comparing the drawing (Fig. 2) of a copper horse, which is in my possession, and was dug from one of the *koorghans*, with one of the figures on the accompanying sketch (Fig. 3) of part of an outcrop of rock that for 200 or 300 ft. was covered with carvings and representations of animals and hunting scenes. Instances of similar articles having been found in the ancient mine workings are also known.

The inscriptions were first reported as having been discovered in 1722, and since then several archæologists have studied them. The hieroglyphics are pronounced to bear evidences of Greek influence, and are intended to be read from right to left. As the Greek method of writing from left to right dates from about 500 B.C., it is to be assumed that the authors of these writings must have dissociated themselves from the sphere of Greek influence in order to settle in this country prior to that date. They are generally believed to have been the Scythians, and the date of their occupation of this country, and of all the works that tell of it, is stated to be possibly any time between 500 and 1000 B.C., so that while Babylon was still at the height of its glory, and Nebuchadnezzar had probably not yet eaten grass, these pioneers of the in-

dustry were geologizing, mining, and smelting copper in much the same way as we are doing now.

One other curiosity may be cited. At Goroblagodat, in the northern part of the Middle Urals, some hundreds of years ago, a tribe of devil-worshippers (*voguls*) guarded the secret of an immense deposit of magnetic iron ore. One of their number disclosed it to the incoming Russians, and for his treachery was offered up in fire on the top of the deposit to the particular devil whom his companions worshipped. The accompanying sketch from a photograph bears at once evidence of the truth of this story and of the superstition of the Russians. A chapel was built to this martyr's memory, and a monument bearing a cast iron tongue of flame was erected upon the spot where he was said to have died.

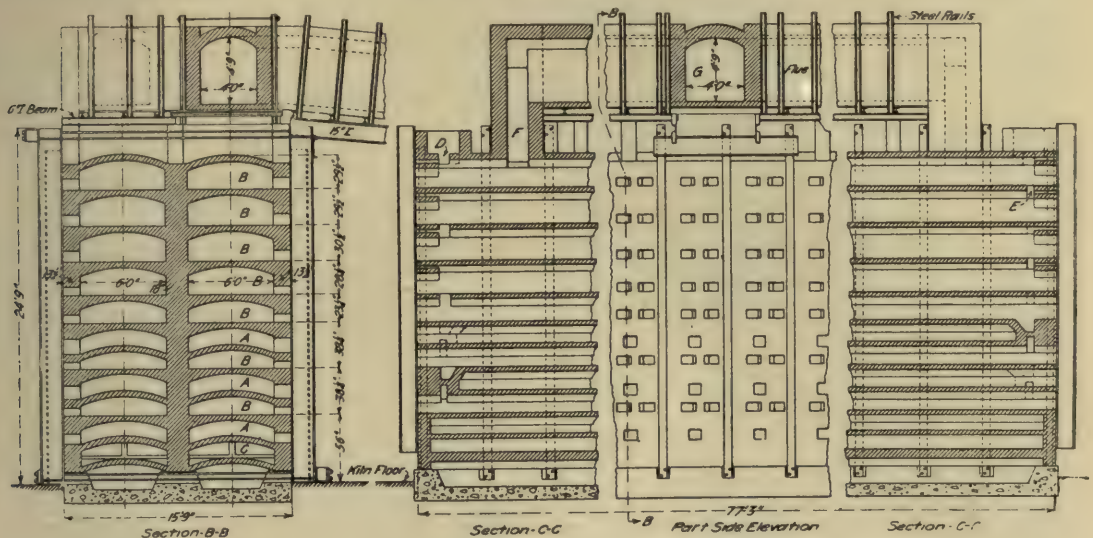
The huge deposit, one of the classic examples of magmatic segregation where the dividing line between magnetite and orthopyre is clearly to be seen, has been attacked continuously for the last 200 years, but no matter how valuable the ore below that chapel may be, it has never been touched, and a great pyramid stands today, hundreds of feet square at the base, to support this monument to the memory of a pioneer.

The Power Production in Great Britain was discussed by Mr. E. G. Hiller in a paper recently read before the Manchester Association of Engineers. Of the 272,000,000 tons of coal raised in Great Britain during 1911, the home consumption was 185,000,000 tons, the remainder being sold abroad or supplied to ocean-going steamers. The home consumption was classified as follows in millions of tons: Factories 60'7, railways 12'8, coasting steamers 2'4, mines 20'5, iron and steel industries 32'1, other metals and minerals 1'1, potteries and chemical works 5'7, gas works 15'4, and household purposes 34'3. An analysis of the boilers used for steam-raising purposes indicates that the water-tube boiler is making headway very slowly, for 45% of the boilers used were of the old horizontal internal-flue type, 25% were of the vertical type, 18% locomotive type, and only 5% of the water-tube type. The contrast between British and American practice in this respect is great, for the water-tube boiler is the standard in the United States. Its unpopularity in this country is stated by the author to be due to the risks in working, which are impressed upon users by the insurance companies.

PRECIS OF TECHNOLOGY

The Rose Lake Zinc-Smelter.—In the *Mining and Scientific Press* for September 12, E. H. Leslie describes the new smelter built near St. Louis, Missouri, by the Granby Mining & Smelting Co. The plant is practically complete, and will start operations shortly. Careful study was made of European and American practice before the designs were made, so that the plant may be considered as providing the most up-to-date example of zinc-smelting. As the heating of the retorts is effected by producer gas made on the spot from coal and not by natural gas, as has been and still is common in Missouri, Kansas, and Oklahoma, the conditions of work are more nearly akin to those ruling in England and Europe. On the other hand, the concentrate treated is of high grade and contains little lead and no silver, so that the extent of the plant is less than is required for treating

rabblés. Rabbling is commenced at the top hearth, and the charge moved from the feed end to the discharge where it falls through a slot on to the hearth below. It travels along the lower hearths in alternate directions. The rabblés are of ordinary rake type, and are drawn through the furnace by detachable rods. The gas travels in the opposite direction to the charge. It is admitted to the lowest muffle at one end, and is partly burned by the admission of air at intervals. It then passes outside the muffle and is admitted through a by-pass to the next muffle above, where it is further burned, the combustion being finally completed under the third muffle. These furnaces have each a capacity of 50 tons per day. This particular design of furnace has been adopted, as it yields a high-grade sulphurous acid, suitable for sulphuric acid manufacture. The heating gas is made from coal in a Chapman producer, the mechanical feature of which is that its two parts revolve in the same



HEGELER ROASTING FURNACE, TREATING ZINC SULPHIDE AT THE LAKE ROSE ZINC-SMELTING PLANT.

concentrate from Broken Hill. The average assay of the concentrate is 65% zinc and $\frac{1}{2}$ to 1% lead with 30% sulphur, as compared with Broken Hill concentrate averaging 44 to 49% zinc, 5 to 6% lead, and 7 to 10 oz. silver per ton. It is clear therefore that for a given yearly output of zinc the distilling furnaces to treat Broken Hill material would be more extensive than those at Rose Lake, and additional plant would be required for the treatment of leady residue and for desilverization.

The storage bins for the concentrate have a capacity of 5000 tons, and the plant is designed to treat 100 tons per day. The design has been such that the plant can be readily duplicated. The concentrate is delivered to two modified Hegeler roasting furnaces, each housed in a separate building. Each furnace is 22 ft. wide, 32 ft. high, and 84 ft. long, and has 7 hearths. The three lower hearths are heated by producer gas. The hearths are arranged with muffles on each side of the centre wall. The concentrate is fed at opposite ends of the two top hearths, and discharged at the two opposite ends of the bottom hearths. The passage of the concentrate through the muffles is effected by

direction at different speeds, thus preventing clinkering and discharging the ashes automatically in a crushed condition. The sulphuric acid plant is of the standard lead-chamber type.

The distilling furnaces are four in number, each measuring 108 by 18 ft. The retorts are placed in 5 rows with 81 in each row, making 405 on each side or 810 altogether. The installation contains altogether 3240 retorts. The retorts measure 52 in. in length and the vertical inside diameter is 9 in. The charging is done by hand, and the discharging by means of scrapers, following Illinois practice. The furnaces are built on the elevated-floor type, and present a contrast to European practice, where the heating is done from an excavated chamber. The gaseous fuel is generated in 12 Hughes gas-producers. The furnace-charge of roasted concentrate, coal, etc., is mixed in a machine similar to a concrete mixer. As the furnace floor is 20 ft. above ground level, the residue from the retorts is easily discharged by gravity into cars that take it to the dump. Mr. Leslie describes the manufacture of retorts by the hydraulic press and the chambers for drying the retorts, and also the power

plant and accessory apparatus and buildings. The outlay on plant is given at \$1,500,000. Whether this is the total capital expenditure required to construct the plant and commence operations is not quite clear.

Coloured Labour on the Rand.—In his presidential address at the meeting of the South African Institute of Engineers held in August, Edward J. Way stated the case for the adoption of coloured skilled labour in mines on the Rand. At the present time no native is recognized as a skilled labourer. Supervision and skilled labour is entirely in the hands of highly-paid white men, though in a great many cases the so-called unskilled native actually does the skilled work under the supervision of a less competent white man. Mr. Way's experience is that a large proportion of white labour could be replaced by skilled coloured labour without any detriment to the quality of the work done and with a substantial decrease in the working cost. By such a rearrangement of the conditions of employment operations could be greatly extended, so that the displaced white men would readily find other work, while the conditions of employment based on piece-work would prove so attractive to the native that recruiting would become unnecessary and a large expense thus avoided. Mr. Way points out that at the diamond mines and at Rhodesia gold mines the conditions during the last few years have been such that the native is a willing worker and recruiting is unnecessary. On the Rand the remuneration of the native is on fixed lines and there is little incentive to individual effort; the white man in many cases reaps the reward of the native's exertions; and living conditions are not what they should be as regards health, family life, and recreation. Mr. Way considers also that the number of accidents, such as those due to falls of roof, would be substantially reduced, for a large proportion are now caused by the carelessness of the white gangers; if the responsibility for the inspection was with the natives actually engaged on the spot greater care would be exercised.

Mr. Way proceeds to analyse the white labour employed at a well known mine on the Rand, its name not being mentioned, and he shows that by withdrawing men from stoping, timbering, development work, etc., and employing more high-class overseers, he could reduce the total white complement from 301 to 159 and their wage-bill from £9245 to £4360. The following staffs of white labour would be entirely eliminated: hand-stoping 5, reclaiming 1, machine stoping 41, shovelling and tramping 40, rock-walling 14, skipmen 15, winch-drivers 7, drill-carriers 4, stope-watering 8, shaft-sinkers 2, hand development 1, and machine development 20; he would reduce the number of timbermen from 31 to 4, plate-layers from 4 to 3, and increase the supervisors from 16 to 66; the following would not be altered: machine learners 21, banksmen 5, on-setters 5, engine-drivers 6, pump-men 5, shaft-maintenance 26, sanitation 1, fan-drivers 2, and surveyors and samplers 11. The wages paid to these white workers vary from £50 per month for machine stoping and development to £15 per month for stope-watering.

Mr. Way then gives an outline of the wages paid at a dividend-paying gold mine in Rhodesia where nearly all the skilled work is done by natives. The engine-drivers, responsible for the hoisting of the ore and the raising and lowering of the miners, are paid 1s. 6d. per day together with 6d. for food. Natives who sharpen the hand-drills receive 1s. 4d. plus 6d. The native carpenters cut the setts for the shafts by template and are paid 1s. 4d. plus 6d., and the timbermen are paid at the same rate. The machine-drillers

receive 1s. 10d. plus 6d., and track-layers 1s. 4d. plus 6d. A native electrician receives 2s. 4d. plus 6d. per day. The white supervisors have control of from 70 to 80 natives and receive wages from 16s. 8d. to 27s. 6d. per day. Mr. Way takes these rates of native wages and applies them to a mine on the Rand where 460 Europeans were working during May of this year. Of these, 218 were underground men and 242 surface workers. Of the 218 underground men, 149 could be replaced by natives, and the total wages reduced from £6907 to £3359, equivalent to a saving in the cost per ton milled of 1s. 4d. Of the surface workers, 133 could be replaced, and the wages reduced from £6833 to £4394, a saving equal to 11d. per ton milled. Mr. Way considers that an additional saving per ton of 9d. or 1s. could be gained by introducing a scale of remuneration based on results and conducive to individual effort. Mr. Way concluded by urging that this proposed alteration in labour conditions would effect a greatly desired improvement in economic conditions on the Rand.

Tin Lodes in Kinta Valley.—A paper was recently read before the Federated Malay States Chamber of Mines by J. B. Scrivenor, Government Geologist, describing the occurrence of cassiterite in lodes in the crystalline limestone on the west side of the Kinta valley, Perak. Mr. Scrivenor, in an official report published eighteen months ago, of which an abstract was given in our issue of May 1913, showed that cassiterite is found in several modes of occurrence genetically different. Most of the mineral now mined comes from the gravel-clay beds of Permo-Carboniferous age overlying limestone, and his report then dealt chiefly with these beds. The lecture now quoted describes in detail the lodes traversing the limestone, containing cassiterite that has been deposited at the period of the formation of the lodes. Care has to be exercised in deciding whether certain rocks containing cassiterite, enclosed in crevices in the limestone, are true lodes or not, for often they prove to be only cemented detritus. It has often been supposed by casual students of mining that the only lode-tin mine in the Malay peninsula is the Pahang, and that the Perak tin is derived solely from alluvial deposits. Mr. Scrivenor's present paper will dispose of this misconception. The error should not have arisen, for R. A. F. Penrose in his historic paper published in 1903 ('Tin Deposits of the Malay Peninsula,' *Journal of Geology*, Chicago) describes these tin lodes and gives a theory of their origin. Tin-bearing lodes in limestone are found in other parts of the world, in Tuscany, Maine, Texas, Finland, Saxony, and Alaska. Mr. Scrivenor describes these briefly, giving references to the literature relating to them. He then proceeds to describe the lodes found at seven different places. The nature of the deposits is such as to suggest that the word 'pipe' is more suitable than 'lode.' The deepest working is at Menglembu, where a Chinese owner has sunk to 250 ft., at which point the orebody measures 50 by 20 ft. in area. The minerals are cassiterite, pyrite, and arsenopyrite, and the average content of cassiterite in the ore mined is over 20%. No fluor-spar or tourmaline has been detected. At the Penkalan in the same neighbourhood, several pipes have been disclosed. One measuring 14 by 3 ft. at the surface of the limestone was found. Here the ore consisted of calcite, cassiterite, chalcopryite, bornite, pyrite, arsenopyrite, with tremolite, green fluor-spar, and a little quartz. Excellent specimens were found of cassiterite intergrown with tremolite. Two other deposits have been worked on the Penkalan property, and are down 50 ft. and 20 ft. respectively. These

are narrow pipes, and contain no quartz, tourmaline, or tremolite. The cassiterite occurs as minute grains, and also as large grains scattered through calcite. At Ayer Dangsang, near Lahat, a French company commenced to develop a deposit in 1905. In 1913, the shaft was 200 ft. deep, at which point the orebody measured 60 by 5 ft. The ore contains calcite, cassiterite, fluor-spar, and copper minerals, but no quartz or tourmaline. Mr. Scrivenor also describes similar occurrences partaking of the nature of stockworks, and veins containing tourmaline and copper and arsenic

disseminated in a fine state. As regards extent, the orebodies are narrow, and in no case has their eventual depth been ascertained.

The orebodies are undoubtedly metasomatic alterations of the limestone, caused by mediums connected with the granite of the Kledang range to the west of the Kinta valley. All the orebodies so far disclosed are not far from this granite outcrop. The granite is younger than the limestone and was intruded into it. Similar orebodies are found in the granite and some are worked near Menglembu. The probability is that the pipes in the limestone are continuations of pipes in the granite. But so far, the exploratory work has not been sufficient to disclose the junction of the two rocks at a point where pipes are present. In the tin-bearing pipes in the granite, tourmaline is abundant, tremolite has not been found, fluor-spar is not common, white mica occurs where the cassiterite constituent is large, and metallic sulphides are not abundant. On the other hand in the pipes in the limestones, tourmaline is rare, tremolite and fluor-spar are common, little mica is known to exist, and metallic sulphides are abundant. The relatively large amount of tourmaline in the pipes in the granite confirms the theory that tin is brought into the orebodies as borate. Reaction would take place between the boron and the alumina, alkalis, and silica of the granite, with the formation of the tourmaline, but as these substances are absent in the case of limestone, no tourmaline would be formed there. Tremolite is a silicate of magnesium and calcium, and the supposition is that the silica came with the tin and reacted with the metals of the limestone; as the amount of lime in granite is small, little tremolite could be formed there. Similarly the presence of calcium in limestone and its absence in granite is the cause of most of the fluor-spar being in the limestone. From these considerations it may be inferred that boron, silica, and fluorine accompanied the tin that was brought into the limestone. The boron that came into the limestone would be changed to boracic acid and removed in solution. As regards the differing amounts of sulphides and arsenides in the granite and the limestone pipes, the explanation is that these minerals are formed at comparatively low temperatures, and that the temperature of the limestone was lower than that of the granite, in fact at a level conducive to the precipitation of these minerals. Mr. Scrivenor considers that the cassiterite and associated minerals were of pneumatolytic origin, being formed by jets of vapour bursting through granite which was hard but still hot. He controverts Penrose's theory that their deposition was due to hydrothermal action.

Metasomatism in Banket.—At the April meeting of the Geological Society of South Africa, R. B. Young gave some instances of replacement of minerals in the Transvaal banket, and presented arguments in favour of the theory that some of the gold and pyrite were constituents of the pebble beds before cementation and the rest introduced by metasomatic action after the consolidation of the beds into banket. The first example of metasomatism mentioned by him is at the Rose Deep, where on the South Reef Leader, between the 8th and 9th levels, the quartz of the banket, for an extent 170 ft. along the strike and 60 ft. on the dip, has been altered to a mixture of chlorite and sericite. This altered rock has the appearance of a soft compact clay of dull green colour. On washing this soft rock in water, a concentrate is obtained containing pyrite, zircon, chromite, anatase, and gold. Of these all but anatase is found in the unaltered banket, in which, on the contrary, the titanium occurs as rutile. It is as-



minerals but no cassiterite. In one case argentiferous galena was found associated with cassiterite, together with some scheelite.

In discussing the characteristics of these orebodies, Mr. Scrivenor is inclined to consider that the failure to identify the presence of fluor-spar and tremolite in some of the specimens of ore is not to be taken as indicating their absence, and that their general abundance elsewhere tends to the supposition that in the exceptional cases these minerals are so fine-grained as to escape notice. On the other hand, the rareness of tourmaline is an established fact, so that the mineral cannot be regarded as characteristic of the orebodies. The amount of mica is small, but it is probably widely

sumed that in the process of replacement, the rutile was taken into solution and anatase subsequently precipitated. A second instance of metasomatism described by Mr. Young is the calcification of banket at the Paarl Central, part of the Crown Mines. Here the quartz pebbles of the banket are completely or partly changed to calcite. This case is similar to the calcification recorded a few years ago at the Meyer & Charlton. A third instance quoted by Mr. Young relates to the pebbles of pyrite found in the Black Reef at the Machavie mine in the Klerksdorp district. At this mine, the banket pebbles consist of vein-quartz, quartzite, cherty rocks, chlorite, and pyrite. The pebbles of pyrite are plentiful. They are mostly flattish with rounded edges, and seldom spherical, and their irregularities are reminiscent of a soft slaty rock. In some cases they exhibit internally a radiate structure, and usually their surfaces are slightly roughened by projecting edges and corners of pyrite crystals. Some of the pebbles in the banket are composed of a slaty rock consisting of chlorite containing minute scattered grains of quartz and of a similar shape to the pyrite pebbles. These are occasionally found partly composed of pyrite in all stages of replacement, and the assumption is that the pyrite pebbles are replacements of the slaty chlorite pebbles. The original source of these chlorite pebbles is apparently the quartz-chlorite rock of slaty character found in the Ventersdorp System.

All the replacements of quartz in the banket known to Mr. Young have, in his view, occurred late in the history of the rock after complete cementation of the pebbles, and not during its earlier greater permeability. It is also evident that the metasomatism occurs almost entirely in the banket and not in the adjoining quartzites; moreover, the banket is more intimately fractured than the quartzites. It is assumed that the orogenic forces in the uplifting and bending of the beds have attacked the more easily fractured banket, and that the more resistant quartzite has suffered to only a small degree. These networks of fractures have afforded entry for the mineral solutions. It is generally held by geologists that the mineralization of the banket was effected by solutions during or before the course of cementation, but Mr. Young's evidence now presented shows that much of the pyrite and some of the gold were deposited at a period after the final cementation, and through fractures. It is probable that precipitation from these subsequent solutions was induced by the pyrite, gold, and carbon already in the banket.

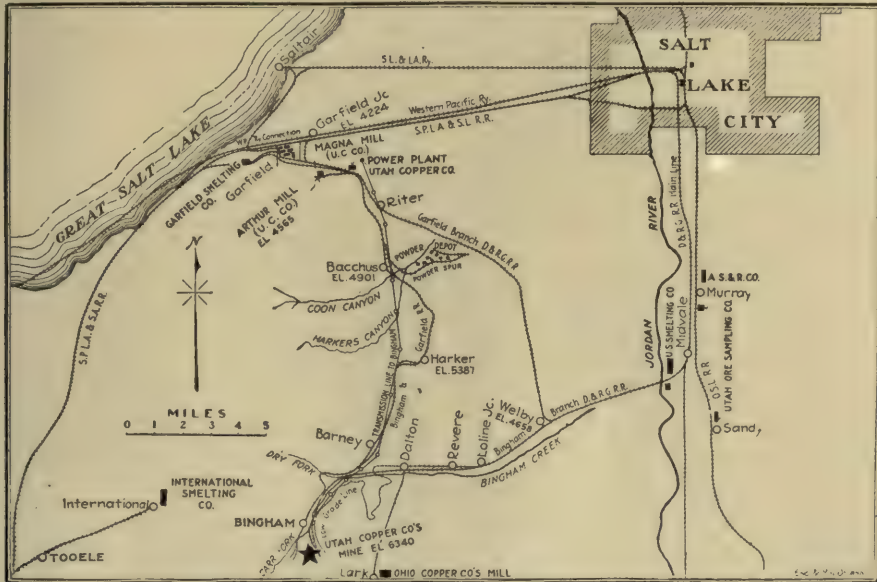
Calumet & Hecla Tailing.—The *Mining and Scientific Press* for September 5 contains an article describing the plant installed for re-treating tailing from the Calumet & Hecla copper mine that had been discharged into the lake. As is well known to our readers, the ore at this mine contains copper in native condition. As the mine becomes deeper and the ore poorer, the tailing discarded in the old days, of a grade nearly equal to the ore now mined, becomes valuable. A double system of pump-dredges has been installed for raising the old tailing from the lake bed and delivering it to classifying and concentrating plant. The slime from the classifiers goes direct to Wilfley tables, and the sand to Hardinge mills and then to Wilfleys. The scale of operations may be gauged by the fact that there are 64 Hardinge mills, each with a capacity of 35 tons per day. About half of the copper content is recovered on the Wilfleys. The tailing is sent to a leaching plant, devised by C. H. Benedict, the company's metallurgist, where the copper is treated by the ammonia process. It was

impossible to use acid as a solvent, because the ore contains too much carbonate of lime. The fact that the copper is in native form was a difficulty in applying the ammonia reaction, for metallic copper is not attacked by ammonia, just as is the case with some acids. The process at the Calumet & Hecla depends on the presence of a microscopic coating of oxide on the copper. This oxide is dissolved by ammonia in the presence of an ammonium salt such as the carbonate, forming a cuprammonium salt. If an oxidizing agent is present in the solution, the film of oxide of copper is renewed, and the process becomes continuous. The copper is recovered as oxide by the removal of the ammonia by distillation. As is well known, the efficiency of the process depends on the recovery of the ammonia. It is stated that the sand sent to the leaching vats contains from 6 to 6½ lb. copper per ton, and that from 4½ to 5 lb. can be recovered by leaching. The working details of the process as applied at Calumet & Hecla are not given, as patents are pending. No doubt the subject matter of these patents contains the improvements which have induced the company to adopt the cuprammonium reaction. The plant consists of 16 vats, each to contain 1000 tons of sand, measuring 54 ft. in diameter and 12 ft. in depth. The treatment will occupy 4 days.

Utah's Early History.—In welcoming the members of the American Institute of Mining Engineers visiting Salt Lake City on the occasion of the summer meeting held in August, D. C. Jackling, manager of the Utah Copper Co., gave an address outlining the mineral history of the State of Utah. The first record of the appearance of white men in Salt Lake district was in 1776, when two Spanish priests left Santa Fe, in the northern part of New Mexico, on an exploratory trip with a view of finding a direct route to Monterey, California, which is about on the same level of latitude. In September of that year they arrived at Utah lake, 50 miles south of Great Salt lake. They heard of the latter from the Indians, but did not visit it, continuing southwest instead. During the winter of 1824, James Bridger, a trapper, came from the northeast down Bear river to Great Salt lake, and in 1832, Captain Bonneville sent an exploring party round the lake. In 1843, John C. Fremont and a party of explorers arrived near the eastern shores of the lake, at a point where the town of Ogden now stands. He wrote a report of his travels, and it was published by the Government. The information given in this way is assumed to have influenced Brigham Young when he was searching for a destination for the Mormon emigration. Young arrived in Salt Lake valley in July 1824. For ten years the energies of the Mormon settlement were devoted to the reclamation of the desert lands for agricultural purposes, and no thought was given to mineral deposits. The first recorded mine was the Jordan, discovered in 1863, situated in what is now known as the West Mountain mining district, in Bingham canyon. But no active interest was taken in mining until the arrival of Colonel Patrick Connor in 1862, who with his Californian volunteer army did much work in prospecting. Much evidence was obtained as to mineral deposits, and Connor arranged rules and regulations for their development and exploitation. Under these conditions the Jordan mine was developed, but did not give immediately profitable results. Silver-lead ore was discovered in Wasatch, Little Cottonwood, and at Mountain Lake in 1864. In 1868 copper ore was first discovered and some was shipped to Baltimore, and in the same year the famous Emma mine commenced the production of silver-lead ore. The Emma was sold in

1871 to an English company under the auspices of Albert Grant. The next most important discovery was the lead carbonate and sulphide deposits at Big Cottonwood. The completion of the Union Pacific Railway in 1869 greatly helped the development of the state, and in 1870 to 1871 several small lead smelters were established. In the West Mountain district gold placers were found, and for some years hydraulic mining was continued with varying success, the total yield during ten years being worth about £300,000. The West Mountain district has been the centre of the great copper production of the state. The recent history of copper mining dates from 1896, when the Highland Boy and other properties were merged with others into the new corporation, the Utah Consolidated. The Utah Copper company was formed in

disappeared, as have also some later plants that did good work in their time, such as the Bingham Consolidated, Highland Boy, Yampa, Utah, and Tintic. The tendency recently has been to erect plants farther from Salt Lake City, from consideration of both cost of site and fume trouble. The important smelting plants today are those at Midvale, Murray, Garfield, and Tooele. At the Midvale and Murray, lead ores are treated by the United States Smelting Co. and the American Smelting & Refining Co., respectively; the Garfield is devoted solely to copper, and the Tooele to both copper and lead. The Garfield treats the output of the Utah Copper Co. and the Ohio Copper Co. All these smelters treat ores from California, Montana, Idaho, Nevada, Arizona, and Colorado. Sampling plants have been erected at Sandy and Murray.



THE METALLURGICAL CENTRES NEAR SALT LAKE CITY, UTAH.

1903, and the Ohio Copper in the same year. The Park City district was established as a silver-lead producer in 1868, and the first important producer, the Ontario, was discovered in 1872. The Tintic silver-lead district was first prospected in 1869, where the Eureka became a great mine. In Beaver county, 150 miles south of Great Salt lake, the Horn Silver mine was discovered in 1875, and was one of the great silver mines of the world. The later history of copper and lead mining in Utah need not be recapitulated here.

Smelting in Utah.—In the previous paragraph we quote the early history of Utah's mineral development. Supplementary information as to smelting development in Utah is given in the *Engineering and Mining Journal* for August 8. At the time of the discovery of lead deposits near Salt Lake City in 1869 and 1870, each property erected its own smelter, and in 1872 there were 21 lead furnaces at work. They were eventually superseded by smelters erected at or near Salt Lake City for the treatment of both lead and copper ores. Among the first to be erected, the Germania, Hanauer, Horn Silver, and Mingo were excellent types of current practice; but they have now

Analyses of Tin.—At the August meeting of the American Institute of Metals, W. A. Cowan presented a paper recording many analyses of various commercial brands of tin. Mr. Cowan asked for analyses of Banka, Straits, Pyrmont (New South Wales), and Williams-Harvey (Liverpool) brands, and the chemists of the American Sheet & Tin Plate Co., Ledoux & Co., A. H. Knight (for Williams, Harvey & Co.), and the National Lead Co. sent him their results. We give the analyses overleaf, the letters A, B, C, and D referring to analyses made respectively by the companies named. We would remind our readers that in 1912, the London Metal Exchange issued analyses of the various brands of tin, and established a 'standard tin' which permitted tin extracted from complex ores to be accepted as good delivery on contracts. We referred to the new 'standard' tin in our issue of December 1911 and quoted the analyses in our issue of November 1911. The figures presented by Mr. Cowan exhibit wide variations on the part of the analysts; the cause of the discrepancies was the fact that the samples did not come from the same ingots. The figures indeed may be taken to indicate the range of content in particular brands.

| | BANKA. | | | |
|-----------------|---------|---------|--------|---------|
| | A % | B % | C % | D % |
| Lead..... | trace | 0'010 | trace | trace |
| Arsenic..... | 0'024 | 0'004 | trace | none |
| Antimony..... | 0'038 | none | 0'006 | 0'006 |
| Copper..... | 0'003 | 0'009 | 0'002 | 0'004 |
| Cadmium..... | — | none | — | none |
| Bismuth..... | — | 0'002 | none | none |
| Iron..... | trace | 0'004 | 0'023 | 0'019 |
| Zinc..... | trace | — | — | trace |
| Ni & Co..... | — | none | none | none |
| Manganese..... | — | none | — | none |
| Tungsten..... | — | — | — | none |
| Sulphur..... | trace | — | trace | trace |
| Phosphorus..... | trace | none | none | 0'008 |
| Tin..... | 99'935* | 99'971* | 99'963 | 99'963* |
| Total..... | 100'000 | 100'000 | 99'994 | 100'000 |

| | STRAITS. | | | |
|-----------------|----------|---------|--------|---------|
| | A | B | C | D |
| Lead..... | 0'057 | 0'080 | 0'049 | 0'064 |
| Arsenic..... | 0'084 | 0'072 | 0'058 | 0'077 |
| Antimony..... | 0'103 | none | 0'018 | 0'018 |
| Copper..... | 0'013 | 0'027 | 0'020 | 0'020 |
| Cadmium..... | — | none | — | none |
| Bismuth..... | — | 0'003 | 0'004 | none |
| Iron..... | trace | 0'005 | 0'003 | 0'005 |
| Zinc..... | trace | — | — | 0'015 |
| Ni & Co..... | — | none | none | none |
| Manganese..... | — | none | — | none |
| Tungsten..... | — | — | — | none |
| Sulphur..... | trace | — | trace | 0'009 |
| Phosphorus..... | trace | none | none | 0'010 |
| Tin..... | 99'743* | 99'813* | 99'831 | 99'782* |
| Total..... | 100'000 | 100'000 | 99'983 | 100'000 |

| | PYRMONT (NEW SOUTH WALES). | | | |
|-----------------|----------------------------|---------|--------|---------|
| | A | B | C | D |
| Lead..... | 0'019 | 0'045 | 0'016 | 0'045 |
| Arsenic..... | 0'020 | 0'035 | 0'019 | 0'038 |
| Antimony..... | 0'054 | 0'074 | 0'051 | 0'098 |
| Copper..... | 0'023 | 0'027 | 0'015 | 0'024 |
| Cadmium..... | — | none | — | none |
| Bismuth..... | — | 0'010 | 0'007 | none |
| Iron..... | trace | 0'003 | 0'003 | 0'003 |
| Zinc..... | trace | — | — | 0'010 |
| Ni & Co..... | — | none | none | none |
| Manganese..... | — | none | — | none |
| Tungsten..... | — | — | — | none |
| Sulphur..... | trace | — | trace | trace |
| Phosphorus..... | trace | none | none | 0'020 |
| Tin..... | 99'784* | 99'806* | 99'866 | 99'762* |
| Total..... | 100'000 | 100'000 | 99'977 | 100'000 |

| | WILLIAMS, HARVEY & CO., LIVERPOOL. | | | | | |
|-----------------|------------------------------------|---------|---------|---------|---------|---------|
| | Common | | | | Refined | |
| | A | B | C | D | C | D |
| Lead..... | 0'339 | 0'374 | 0'380 | 0'387 | trace | 0'010 |
| Arsenic..... | 0'038 | 0'078 | 0'060 | 0'077 | 0'049 | 0'061 |
| Antimony..... | 0'336 | 0'220 | 0'215 | 0'252 | 0'032 | 0'039 |
| Copper..... | 0'075 | 0'100 | 0'060 | 0'090 | 0'015 | 0'014 |
| Cadmium..... | — | none | — | — | — | none |
| Bismuth..... | — | 0'070 | 0'059 | 0'064 | 0'002 | none |
| Iron..... | trace | 0'008 | 0'004 | 0'002 | trace | 0'003 |
| Zinc..... | trace | — | — | 0'006 | — | 0'012 |
| Ni & Co..... | — | none | 0'007 | none | none | none |
| Manganese..... | — | none | — | none | — | none |
| Tungsten..... | — | — | — | none | — | none |
| Sulphur..... | trace | — | 0'002 | 0'006 | trace | trace |
| Phosphorus..... | trace | none | trace | 0'007 | none | trace |
| Tin..... | 99'212* | 99'150* | 99'260 | 99'109* | 99'920 | 99'861* |
| Total..... | 100'000 | 100'000 | 100'047 | 100'000 | 100'018 | 100'000 |

* By difference.

The letters A, B, C, D, refer to analyses made by the American Sheet & Tinplate Co., Ledoux & Co., A. H. Knight (for Williams, Harvey & Co.), and National Lead Co., respectively.

Holt-Dern Chloridizing Furnace.—The July *Bulletin* of the American Institute of Mining Engineers contains a paper by Theodore P. Holt, describing a chloridizing process, invented by himself and G. H. Dern, at work at Park City, Utah, where a low-grade complex silver ore is treated. A further description of the process is given by F. Sommer Schmidt in the *Mining and Scientific Press* for August 29. The ore is mixed with common salt and powdered coal, as usual, but the furnace is of a different type from any hitherto used for chloridizing. The charge is fed in a

damp state continuously down a shaft-furnace, up which a gentle blast is forced. The physical effect is somewhat like that of sintering, and the discharged material is similar to that issuing from a sintering plant. It is claimed that in consequence fine grinding is not necessary, as effective chemical reaction and subsequent removal by leaching can be obtained with coarse ore. It is also stated that the damp layer on top prevents the escape of fume and dust.

Graphite in Kirkland Lake Ores.—In the *Canadian Mining Journal* for September 1, John A. Dawson gives particulars of the presence of graphite in the gold ores found in the Kirkland Lake district. As we have already recorded in abstracts from the same journal, confusion has arisen among prospectors and even mineralogists as to the nature of the mineral of shining bluish-black lustre found in these ores, some holding it to be molybdenite and others graphite. These minerals are easily mistaken for each other, and in fact they were not recognized as distinct minerals until 1750, both passing indifferently under the name plumbago. Mr. Dawson took a hand sample from the ore mined in Vein No. 1, of the Tough-Oakes property. This sample measured 2 by 2 by 5 in. Native gold and pyrite could be seen on the selvage faces and particularly along a thin dark seam through the quartz-calcite-chlorite gangue. On the flatter of the two lateral faces, the dark material occurred in thick films over the other minerals. When the specimen was analysed quantitatively, tests for molybdenum gave a negative result. Tellurium was determined by reduction with sulphur dioxide. Carbon as graphite was estimated by oxidation with chromic and sulphuric acids and the weighing of the carbon dioxide formed. The analysis gave: 15'03% graphite, 10'95% pyrite, 0'17% gold, 0'09% silver, 0'25% tellurium, and the remainder silica, calcite, and silicates. Thus in Mr. Dawson's specimen the black material was graphite, not molybdenite. It will be remembered that Charles Spearman, in a paper quoted in our July issue, described many microscopic sections in which molybdenite was present but no graphite.

Steam-Power from Slag.—A paper presented last month by Walter L. Johnson to the Iron & Steel Institute describes the plant erected by Bell Brothers at Middlesbrough for utilizing the heat of slag for steam-raising purposes. The invention of the low-pressure steam turbine made it possible to consider the problem of using the heat of slag in this way, for the steam generated by pouring slag into water is at not much higher pressure than the atmosphere, and power can only be generated from it by its condensation. But the steam produced in this way is not in a physical condition fit for the steam engine, as many experimenters have found, for it contains gases other than steam and also finely divided sulphur. The slag produced at Bell Brothers' iron blast-furnaces consists of about equal parts of silica (28'3%), alumina (24'78%), and lime (32'39%), with small quantities of sulphide of lime (3'67%), ferrous oxide (0'3%), manganese oxide (0'36%), magnesia (8'94%), and alkalis (1'26%). The steam produced contains about 0'5% by volume of uncondensable gases, of which 55% is hydrogen, 29% sulphuretted hydrogen, and 16% nitrogen. When this steam was used direct, it was necessary to absorb the sulphuretted hydrogen by passing through milk of lime and the hydrogen by passing over hot calcined ironstone. Nevertheless, sulphur was gradually accumulated as a fine powder on the turbine blades. It was decided eventually to interpose a Kestner evaporator, or 'calandria,' between the generator and the turbine, and to use the dirty steam for evaporating

clean hot water, and thus producing a steam fit to be used in the turbine. The calandria consists of a series of thin long vertical tubes arranged within a steam-tight shell. The clean water to be evaporated is fed into the tubes, and the dirty steam into the space surrounding the tubes, within the shell. The dirty steam on losing its heat condenses, and the uncondensable gases accumulate. When the percentage of the latter reaches 7½%, it is necessary to open a port and draw away the gases. In this way 6.6% of the total steam is lost. Investigations have shown that on an average 1017 lb. of dirty steam is generated per ton of slag. Deducting the 6.6% loss by escape with the uncondensable gases, 950 lb. was effective in the evaporator. The evaporator gave clean steam equal to 90% of the dirty steam, or 855 lb. of clean steam per ton of slag. A modern exhaust-steam turbine, working under full load and with a vacuum of 28½ inches, uses about 27 lb. of steam per horse-power hour, so 31.6 horse-power per hour should be produced from one ton of slag. We may state, as an addendum to Mr. Johnson's paper, that the plant is made by Slag Power, Limited, a company which four years ago consolidated the patents of Claude Vautin and Walter L. Johnson. We gave a short account of Mr. Vautin's design in our issue of April 1910.

Germany's Supply of Iron Ores.—The *Iron and Coal Trades Review* for September 25 contains an editorial article analysing the present position of Germany in regard to the supply of iron ores. The most recent available statistics are those for 1912, according to which the consumption of iron ore in Germany was 39,000,000 tons, of which 12,000,000 tons was imported. The chief imports by countries were: Sweden 4,300,000 tons, Spain 3,726,000 tons, France 2,690,000 tons, and Russian Lapland 650,000 tons. The ore from Sweden is high in grade, 60% and over, but it contains phosphorus. The Spanish ore is of high grade and is free from phosphorus. The domestic supplies of ore come largely from Lorraine and Luxembourg, the latter though nominally an independent state being included in the German customs union. The ore mined in Rhenish Prussia and Westfalia is minette, not containing more than 33% iron. Nearly all the German ore is phosphatic, a fact that accounts for the general use of the basic or Gilchrist-Thomas process. The output of pig iron in Germany during 1913 was 19,000,000 tons. The war is affecting the German iron industry in many ways. The supplies of Spanish and French ores are cut off. No doubt the mines in Lorraine and Luxembourg are partly closed; in any case transport of the ores to the blast-furnaces in Rhenish Prussia and Westfalia will be checked by the monopolizing of the railways for military purposes. The only foreign country from which supplies may be readily obtained is Sweden, and there are two adverse circumstances in connection with the delivery of these ores. In the first place they have been shipped from the north Baltic ports to Rotterdam, either through the Kiel canal or round the coast of Denmark, Rotterdam being much nearer Düsseldorf than any German port either on the North sea or in the Baltic. The declaration of the British Government that it considers iron ore as contraband of war may upset the present arrangements for delivery. If the supplies of Swedish ores are to be maintained, delivery would have to be made through Lübeck, and of course the Russian fleet in the Baltic must not be forgotten. The second difficulty is that the Swedish government restricts the output of the mines. During 1912, the output was 6,700,000 tons, of which Germany took 4,300,000 tons, Great Britain 600,000 tons,

and other countries 600,000 tons, while 1,200,000 tons was used locally. It is quite probable that the Swedish government may relax the export limitation in Germany's favour. Moreover, the government may be influenced by the experience of Russia in connection with the Caucasus manganese industry; here the restriction of the output greatly damaged the industry, as consumers found other supplies, in India and Brazil. German iron-masters have of late years sought other outside sources of ore, a notable example being the Mannesmann enterprise in Morocco.

CURRENT LITERATURE

Ventilation in Lake Superior Iron Mines.—At the meeting of the Lake Superior Mining Institute, held on September 1, Edwin Higgins presented a lengthy paper describing the air conditions underground in the Lake Superior iron district and making suggestions for improvement.

Tube-Mill Efficiency.—In the *Engineering and Mining Journal* for September 12, R. T. Mishler recounts the experiments at the Lucky Tiger mine, in Sonora, Mexico, undertaken with a view to finding the most efficient rate of feed for short tube-mills.

Fluor-spar in Electric Iron Smelting.—In the *Mining and Scientific Press* for August 29, Robert M. Keeney recounts experiments relating to the role of fluor-spar in electric furnaces for the smelting of iron ore.

Utah Metallurgy.—The *Bulletins* of the American Institute of Mining Engineers for July, August, and September and the *Engineering and Mining Journal* for August 8, 15, 22, 29, contain many papers describing metallurgical enterprises near Salt Lake City, connected with copper and lead.

Low-Pressure Blast-Furnace.—In the *Engineering and Mining Journal* for August 1, Ellis W. Honeyman describes a blast-furnace erected by the Detroit Copper Co., at Morenci, Arizona, to treat fine concentrate under low pressure. It is stated that the dust-losses are small and that the plant is much cheaper than a reverberatory.

Copper Assay.—In the *Engineering and Mining Journal* for August 1, W. W. Brostrom gives details of a method of conducting the potassium-iodide assay for copper.

El Paso Smelter.—In the *Engineering and Mining Journal* for September 12, Richard H. Vail commences an article describing the smelter at El Paso, Texas, belonging to the Consolidated Kansas City Smelting & Refining Co. Plant was first erected in 1886 for treating custom lead ores. When the supply of lead ore commenced to dwindle a few years ago, a copper-smelting establishment was added. A new copper plant was built two years ago to treat concentrate from the Chino mine.

Gold Placers in Colombia.—In the *Mining and Scientific Press* for September 12, C. S. Haley describes prospecting expeditions among the gold gravels in the Upper Magdalena valley, Colombia.

Zinc in Tennessee.—The *Engineering and Mining Journal* for September 5 contains an article by A. H. Purdue describing the zinc deposits of Tennessee and the mines now being worked.

Zinc Position in the United States.—In the *Mining and Scientific Press* for August 22 and 29, C. E. Siebenthal describes the present position in the United States as regards the production of zinc, and reviews the probable effect of the war on the zinc industry of the old and new world.

Mining in French Guiana.—In the *Engineering and Mining Journal* for September 19, B. M. Snyder describes the mining conditions in French Guiana. The natives work placers for gold, but no modern plant has yet made a profit.

Northwest Australia.—In the *Mining and Scientific Press* for August 29, A. W. Allen describes the mineral resources of northwest Australia.

French Iron-Ore Deposits.—The *Iron & Coal Trades Review* for September 25 and October 2 contains a paper by Paul Nicou on the iron-ore deposits of France. This paper was to be read at the autumn meeting of the Iron & Steel Institute which had to be abandoned on account of the war.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

The Directors' Handbook: A Guide for Directors of Joint-Stock Companies. By W. H. Behrens. Cloth, octavo, 260 pages. London: Odhams Limited. Price 7s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is a guide for directors of joint-stock companies. It has been prepared by a well-known solicitor, of the firm of Jenkins, Baker & Co., and is intended not for the legal profession so much as for the use of business men acting as officers to limited liability companies. To such men, vaguely aware of their responsibilities to shareholders and to the public, this book will prove highly acceptable, by affording sign-posts to guide them among the pitfalls of a complicated code. The general powers and appointment of directors are carefully outlined; then the qualification and remuneration incidental to their acceptance of office. The prospectus receives a chapter to itself, deservedly, for here is one of the blocks of stumbling. Not only does the author define the liabilities of directors for untrue statements, but he analyses the relation of the director to the expert on whose report the prospectus is issued. Suggestions are offered for discriminating between true reports on mines and the untechnical statements of incompetent persons. The question of payments to vendors and promoters is another important point. Allotment, commencement of business, authority and powers, conduct and management, audit and accounts are the titles of other chapters. That on the income-tax is most important, for inattention to the details of this matter has been a source of frequent loss to companies. The ascertainment of the 'profit' is another vital subject. The book is handy in size, well arranged, comfortably indexed, and clearly written. We commend it to the directors of all mining companies as a protection against error.

T.A.R.

Unit Construction Costs from the New Smelter of the Arizona Copper Co., Ltd. By E. Horton Jones. Cloth, octavo, 150 pages, illustrated. New York and London: McGraw-Hill Book Co. Price 8s. 4d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This is a reprint of a paper presented to the American Institute of Mining Engineers, and mentioned in our issue of August. The paper gives full details of the estimate of costs of the new plant of the Arizona Copper Company. It is incomplete, seeing that the actual total cost is not given, and that no mention is made of the great extra expense caused by the imper-

fect construction and the badly-managed commencement of operations. After all, the eventual cost is of more value to the mining engineer and metallurgist than the estimated cost. In preparing this book for the Press, the publishers ought to have had some respect for the numbering of the pages. The first page is numbered 1497, and the last 1649, thus following the monthly bulletin of the Institute.

History and Romance of the Petroleum Industry. Vol. I. By J. D. Henry. Cloth, quarto, 320 pages, with many illustrations. Published by the Author at 4 London Wall Buildings, E.C. Price 10s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The author is well known as a journalist and writer on subjects connected with oil and petroleum. He is a master of research, and he has unearthed masses of historical records now generally forgotten. Moreover, he has an attractive style of presenting his subject, and his books are eminently readable. The present is the first of a series of "three or more volumes." The first section is devoted to multitudes of references to mineral oils of all kinds from prehistoric to modern times, and the remainder to a history of the discoveries and developments due to Drake, Kier, and Ferris in the 'sixties in Pennsylvania, following with a great variety of information relating to the expansion of the oil industry of America. Much of the matter relates to the personalities and doings of the venturers and pioneers, and partakes rather of the romantic than technological. With the book is issued a pamphlet describing the relationship of Continental oil sources to the war now raging; this pamphlet shows well the position of Germany in regard to supplies of oil, whether shipped from beyond the sea or brought by land from Roumania and Galicia.

Handbook of Milling Details. Cloth, octavo, 430 pages, illustrated. New York and London: McGraw-Hill Book Co. Price 17s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book has been compiled by the editorial staff of the *Engineering and Mining Journal* from articles and short notices appearing in its pages. The subjects treated are sampling, ore-dressing, wet metallurgy, smelting, and refining. The table of contents and the index are both full, and will help the reader to grasp the value of the information contained in the book and to find the references to the particular subject on which his researches may be centred. Three years ago a similar book on mining details was published and gained great acceptance.

Iron Ores: Their Occurrence, Valuation, and Control. By Edwin C. Eckel. Cloth, octavo, 430 pages, illustrated. New York and London: McGraw-Hill Book Co. Price 17s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The scope of this book is partly technical and partly commercial, and to the American reader presents an excellent résumé of the chief deposits, the costs of working them, and the prospects of industrial development. The first 100 pages is devoted to the geology of iron-ore deposits, and the next 70 pages to valuing, prospecting, cost of mining, concentration, and impurities associated with the ores. Part 3 contains a description of the various ore deposits in the United States and other parts of the world, and Part 4 contains an investigation into the iron resources of the world, with a discussion as to the best policy for conservation and future development. The matter relating to the United States has been collected and

collated with care by the author, during a long course of study and professional practice. He relies on other sources of information for his pages on ores in foreign countries, and his remarks and records are not dependable. For instance, he makes no mention of the Iron Knob deposit now being worked by the Broken Hill Proprietary. Not only is the deposit a big one, but it is the basis of an important Australian iron and steel industry. Seeing that the Anglo-Australian controllers of this business placed full reliance on American technologists for the location and design of the treatment plant, and that an American has been appointed manager of the new works, it is surprising that Mr. Eckel does not take the opportunity of giving some credit to his own countrymen.

COMPANY REPORTS

Bell Reef Development.—This company was formed in 1910 to acquire the Bell gold mine in the Gwelo district of Rhodesia, a few miles to the west of the Globe & Phoenix. In 1912 the control was transferred to the Gold Fields Rhodesian Development Company. The old machinery was superseded by modern plant, including a roasting equipment. The report for the year ended March 31 last shows that the metallurgical plant was started on February 7. Little development had been done during the year, beyond sinking the shaft to the 9th level, developing the lode at the 7th level, and proving its continuance on the 8th level. The ore reserve on March 31 was estimated at 56,788 tons, averaging 12.4 dwt. per ton, as compared with 42,495 averaging 12 dwt. the year before. The share capital is £181,338, and £50,000 has been borrowed from the Gold Fields Rhodesian Development Co., for the purpose of erecting the new treatment plant. From the commencement of milling until the end of March, 1911 tons was treated for a yield of gold worth £3130. Since that date the monthly outputs have been: April £2956 from 1933 tons, May £4450 from 2528 tons, June £7699 from 3182 tons, July £7629 from 3490 tons, and August £6669 from 3684 tons. The normal capacity of the plant is 4000 tons per month. H. A. Piper, the consulting engineer, hopes that the 'working cost' will be 25s. per ton when the plant is in full order. The new plant consists of ball-mills which crush dry, Edwards roasting furnaces, a tube-mill in which cyanide solution is used, agitation vats, and Dehne filter-presses.

Rooiberg Minerals Development.—This company was formed under Transvaal laws in 1908 for the purpose of reopening ancient tin mines in the Rooiberg range of mountains, 40 miles by road from Warmbaths railway station, and about 75 miles northwest of Pretoria. The promotion was in the hands of the Oceana Company, but the control passed shortly afterward to the Anglo-French Exploration Co. Edward J Way is consulting engineer, and E. R. Schoch is manager. When operations were begun, the plant contained 10 stamps. A new mill was built in 1912, consisting of 10 stamps, a tube-mill, and machines for treating slime. The report for the year ended June 30 shows that recent development has given gratifying results, and the amount of ore stoped has been greater than the estimated supply. The reserve has been well maintained, and the figure at June 30 was 20,097 short tons averaging 4.95% metal. In addition, the dump contains 4292 tons averaging 8.2% metal, and there is 18,848 tons of accumulated middling and slime averaging 2.5% metal awaiting re-treatment. The tonnage of ore milled was 29,181, and 11,462 tons of accumulated middling and slime was re-treated. No separate

estimate is given of the content of the ore and of the re-treated material, but the average of the two together was 3.18% metal. The yield was 1294 long tons averaging 68.5% metal. The percentage of recovery was 78.8, being an improvement of 6% during the year. Experiments continue to be made with a view of increasing the extraction, and after due consideration and trial of a variety of machines for handling slime, it has been decided to extend the installation of Cornish rag-frames. The working cost per ton has been decreased by 6s. 1d. Unfortunately the drop in the price of tin caused a fall in the revenue per ton of 27s. 8d. The total income was £152,889 or 75s. 3d. per ton, and the working cost (including £28,942 development) £97,084 or 47s. 9d. per ton, leaving a working profit of £55,805 or 27s. 6d. per ton. Out of the profit, £9925 was allocated to capital expenditure, £2340 paid as directors' remuneration, £2334 paid as taxes, £5000 placed to reserve fund, and £31,500 distributed as dividend, being at the rate of 17½%. The year before the working profit was £88,198 and the distribution 35 per cent.

Carn Brea & Tincroft.—The tin mines belonging to this company, situated near Camborne, Cornwall, have been worked since 1832, and in the early years were highly profitable. The present company, under limited liability laws, was formed in 1900. Since then profits and losses have alternated, the profits being earned during the two periods of high prices of the metal. For three years, until two months ago, Edward S. King was consulting engineer. New dressing plant is being erected, the funds being supplied on loan by Viscount Clifden, one of the mineral lords. By the advice of James Brothers, the Carn Brea section was closed at the end of last year. The report for the half-year ended June 30 shows that 29,795 tons of ore was raised from the North Tincroft, as compared with 45,537 tons during the corresponding half of last year, when the Carn Brea was also in operation. The yield of tin concentrate was 324 tons, as compared with 391 tons, and the yield per ton 24.4 lb., as compared with 19 lb. The last named figure was nearly the smallest yield ever recorded in Cornwall. The income was £28,090, as compared with £48,009, the fall being explained partly by the drop in the price obtained for the concentrate from £123 to £90 per ton. During the life of the present company the highest half-yearly yield and the highest extraction per ton were 568 tons and 34½ lb., obtained in the first half of 1909, but the price received per ton was only £69. The biggest income was that earned in the second half of 1912, when 455 tons sold for £59,078. During the half-year under review, the sales of wolfram and arsenic brought the total revenue to £31,889, and the working cost was £35,571. Lords' dues came to £1150, and the loss on the half-year's work was £3681. During the half-year ended December 31 last the loss was £12,899, and the present better position is due to the working cost being reduced by £15,000 consequent on the abandoning of the Carn Brea section. William Thomas, the new manager, gives details of the development done at the North Tincroft, which on the whole are promising.

Tomboy Gold Mines.—This company was floated in 1899 by the Exploration Company to purchase a gold mine of that name in the Rocky mountains, above Telluride, Colorado. In 1901, on the approaching exhaustion of the mine, the Argentine property nearby was acquired. In 1911, the Argentine in turn began to give poor results on development, so the Montana group of claims on the opposite side of the valley was purchased from the Revenue Tunnel Company,

the price being £80,000 in cash. The report for the year ended June 30 last shows that 137,456 tons of ore was raised, 80% coming from the Montana and 20% from the Argentine. The yield of bullion realized \$385,611, and the concentrate \$573,446. Other income brought the total revenue to \$1,013,917. The working cost was \$604,376, leaving a working profit of \$409,541. After allowing for the cost in London, the profit in English money was £81,070, out of which £5754 was written off for depreciation, £2732 written off the cost of the aerial tramway, £5000 placed to income-tax requirements, and £62,000 distributed as dividend, being at the rate of 20%. Zinc concentrate is not now being produced, as the Montana ore contains little or no zinc.* W. K. Betty has designed a cyanide plant to treat 400 tons of tailing per day. D. A. Herron, the manager, reports the ore reserve at 215,000 tons in the Argentine, and 237,000 tons in the Montana.

New Modderfontein Gold.—This company belongs to the Rand Mines group, and was formed in 1888 to acquire property in the far east Rand. Milling commenced in 1892 with 10 stamps. The scale of operations has been gradually expanded, and the present equipment contains 180 stamps and 7 tube-mills. The report for the year ended June 30 shows that the strike and other labour troubles of July and January restricted the output of ore, and for eight months the average output was only 38,000 tons per month as compared with a maximum capacity of 52,500 tons. For the remaining four months the figures were normal. The total amount of ore milled was 510,300 tons, as compared with 565,400 tons the year before. On the other hand the cost per ton showed a substantial decrease, and the reserve a remarkable increase, the former falling from 19s. 11d. to 16s. 11d., and the latter increasing from 4,351,000 tons averaging 35s. 5d. to 5,913,700 tons averaging 35s. 3d. The yield per ton milled was 38s. 10d. as compared with 39s. 7d. the year before. The remodelling of the system of working the mine and handling the ore, which was undertaken two years ago, has been practically completed, and the expenditure involved has been justified by the decrease in operating cost. Almost all the ore stoped is now broken by machine drills. When a greater labour force can be maintained, it is intended to increase stoping operations and do more sorting underground. At present only 5% waste is rejected at the surface, and owing to the narrowness of the beds and the large amount of barren partings this figure could be substantially increased by more efficient sorting both above and below ground. In that case, the grade of the ore sent to the mill would be much higher, and moreover it would be possible to attack some of the upper leaders at present left behind. The development footage for the year was 14,527 tons, and the ore exposed thereby 1,990,390 tons averaging 38s. 7d. per ton. Most of this is on the 8th, 9th, and 10th levels in the eastern section of the mine, but work of considerable importance has also been done on two levels started from the Circular shaft, which is situated 1000 ft. to the south of the 11th level and 2000 ft. from the southern boundary of the property. The ore disclosed on these two levels so far does not appear to be of such consistently good quality as in the upper levels. It is intended to erect an additional metallurgical plant at the Circular shaft with a capacity of 40,000 tons per month. The ore raised during the year was 537,600 tons, and after the rejection of 4.9% waste, 511,290 tons averaging 40s. 2d. was sent to the mill. The extraction by amalgamation was 168,048 oz. and by cyanide 67,283

oz., a total of 235,331 oz., worth £990,354, or 38s. 10d. per ton. The working cost was £431,140, or 16s. 11d. per ton, leaving a profit of £559,214 or 21s. 11d. per ton. Out of the profit £69,247 was spent on capital account, chiefly in connection with the equipment of the Circular shaft. The sum of £70,939 was paid to the government as profits tax and rent, and £420,000 was distributed as dividend, being at the rate of 30%. H. Stuart Martin is consulting engineer and E. Miles Sharp manager.

North Broken Hill.—This company belongs to the Baillieu group, and owns one of the most important properties at Broken Hill, New South Wales. During the period, 156,020 tons of ore was raised averaging 16.1% lead, 13.5% zinc, and 7.6 oz. silver per ton. Most of this came from the 950, 1100, and 1250-ft. levels, with a smaller amount removed during development at the 1400-ft. level. The lead dressing-plant produced 27,550 tons of concentrate averaging 70% lead, 6.8% zinc, and 23.6 oz. silver, together with 73,691 tons of zinc tailing averaging 18% zinc, 3.6% lead, and 3.8 oz. silver, and 16,890 tons of slime averaging 13.2% lead, 16.9% zinc, and 9.2 oz. silver. The zinc tailing was sold to the Amalgamated Zinc (De Bavay's). The developments on the 1400-ft. level have continued to be satisfactory. One bore-hole proved the lode to be 110 ft. wide, averaging 16% lead, 11% zinc, and 10 oz. silver. The working cost per ton was 12s. 10d. for mining, 3s. 6d. for milling, and 1s. 6d. for development, a total of 17s. 10d. George Weir, the manager, reports that the policy recently inaugurated, of keeping a reserve of crushed ore at surface, has been advantageous, enabling the mill to work at full capacity notwithstanding many irregularities in the hoisting. The reserve of crushed ore stood at 6929 tons on June 30. The accounts show an income from the sale of lead concentrate, zinc tailing, and slime of £300,994, and a profit of £157,658, out of which £150,000 was paid as dividend, being 25% for the half-year. We refer in our 'Review of Mining' and 'Editorial' to the present position of this and other Broken Hill companies.

Cocks' Pioneer Gold & Tin Mines.—This company belongs to the Baillieu group, and was formed at Melbourne in 1913 to acquire alluvial tin and gold properties on Eldorado creek, near Beechworth, in the north-east of Victoria. It is estimated that there is 35 million cubic yards of alluvium averaging 1s. 5d. per yard. It is to be worked by a monitor and pump-dredge, and the cost is estimated at 5d. per yard. The issued capital is £100,000, of which £50,000 represented vendors' shares. The report for the half-year ended May 31 shows that during this period operations have been confined to the erection of the electric-power and treatment plants, which were expected to be ready by September. Arthur H. P. Moline is general manager.

Mountain Queen.—In our note of the report of this gold mining company operating in West Australia, published in our issue of June last, we gave the capacity of the Holman air-cushion stamp-mill incorrectly. This mill contains 2 stamps, each of which crushed 69 tons of ore per 24 hours. We incorrectly gave this figure for the output of the mill, and thereby did an unwitting injustice to both the manager of the company and the makers of the mill. Our issue of November 1912 contained an abstract of an article by W. R. Degenhart describing the metallurgical plant at the mine, giving details of the stamps, grinding-pans, etc. The ore is partly soft oxidized material and partly hard ferruginous sandstone, and the two sorts are fed concurrently.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor.

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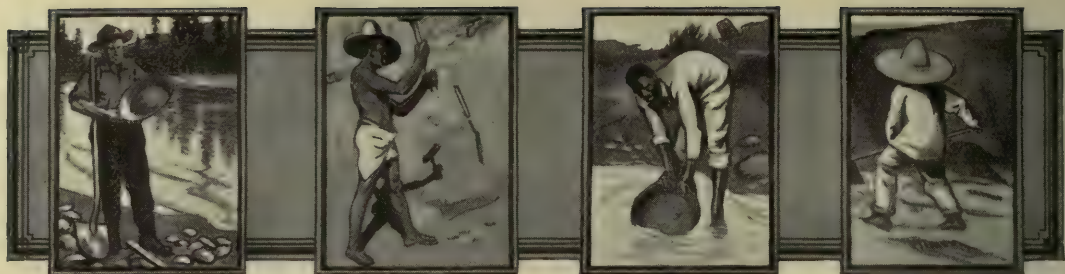
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❖❖ REVIEW OF MINING ❖❖

INTRODUCTORY.—An effort to unravel the financial complexities caused by the war has been made by the Treasury and by the Stock Exchange Committee. We discuss the subject at length elsewhere. The effect of these remedial measures will be more apparent after the settlement, which takes place on November 18. Meanwhile business is restricted to small cash dealings. Any restoration of ordinary business depends entirely upon the success of the Allies on land and sea. Real progress has been made recently, but until some limit can be placed upon the duration of the war, it will be extremely difficult to obtain large sums of money for new enterprise.

TRANSVAAL.—The usual figures for the output of gold and native labour had not arrived when we went to press, owing to the cables being occupied by the government. Though many engineers have volunteered for service, it is not expected that the output will be reduced; nor is the native labour likely to show a fall.

On October 20 the Government Areas started 50 stamps; the other 50 will be brought into service gradually.

During the third quarter of the current year the Brakpan made a notable improvement in tonnage and working cost, the figure for the latter being 17s. 6d. per ton. The total cost, of course, is about 20% more. The nominal or 'working' profit was £81,722, as against £57,786 in the first quarter of the year.

The Consolidated Main Reef makes a good showing for the second quarter, the tonnage increasing by 11,610; the nominal cost was

reduced by 1s. per ton, and the yield raised by 9d. per ton, so that the nominal profit is £34,585 for the quarter. Development results indicate ore of lower grade.

RHODESIA.—The output of gold was well maintained in September, the total production being worth £309,398, as compared with £250,430 in the corresponding month of last year. Among the new producers, the Cam & Motor improved slightly upon its August return, but the extraction is still bad. The Shamva decreased its tonnage and consequent yield, so that a diminution of £7000 is recorded. Among the older mines the Eldorado, Rezende, and Wanderer made small gains, while the Lonely, Thistle-Etna, and Jumbo exhibit decreases. The Globe & Phoenix maintains its large output steadily.

The Globe & Phoenix is being developed successfully in the lower workings, so that the average grade of the reserve has improved to 29 dwt. for 188,000 tons. This compares with 181,300 tons of 27·4 dwt. ore last March, and with 178,582 tons, averaging 36·6 dwt., two years earlier. The reserve is equal to 2½ years mill-supply. Messrs. F. A. Macquisten and J. E. Howard have issued a report based upon their recent visit to the mine. The report is interesting. A little introductory history of the mine is not out of place. A reference to the treatment of slime includes the suggestion that the process is the result of "ingenuity and happy accident." We demur to the latter half of this phrase; 'intelligent observation' would be more nearly correct. These non-technical directors state that

it was noticed that the slime changed colour when left in the open air. This was proved, by experiment, to facilitate extraction of the gold. Now the slime is "weathered on a vast field and ploughed continuously." Is the "vast field" a synonym for the veldt? A description of the metallurgical process was given by Mr. H. T. Brett in our issue of July 1911.

The Gaika makes a highly creditable annual report, the working cost having been decreased by 2s. 8d. to 25s. 11d. per ton. This is not due to increased tonnage, for that has only been raised from 33,549 to 36,928. The yield also has improved from 35s. 9d. to 47s. 1d. per ton. A dividend of 10% for the year is declared. The total cost is 29s. 3d. per ton.

The Tanganyika Concessions is being operated continuously despite warlike operations in the Belgian Congo. Owing to the occupation of Brussels, the staff of the Union Minière, the senior control, has moved to London. Anticipations of a production of copper at the rate of 1000 tons per month are expected to meet with fulfilment this year, arrangements for the sale of the copper have been made, and the new smelter is to be constructed "as soon as circumstances permit." On the whole, the company is to be congratulated on doing so well during this abnormal period.

WEST AFRICA.—The production of gold in September constitutes a new record, despite the short month. At £154,316 the yield was worth £3930 more than that of August. The Abbotiakoona did about £3000 better and the Abosso improved by £2000, while the two leaders, the Ashanti Goldfields and the Prestea, maintained their production, each at about £38,000.

The Jos dredge is finding difficulty in digging into stiff clayey ground, the machine being too light for such work. The pipe-line of the Naraguta has been completed, and a number of nozzles are now engaged. Prospects are excellent.

Lack of water is restricting production in Northern Nigeria. In October, the Rayfield produced only 60 tons of concentrate, or about the same as a year ago, despite the use of the new plant. During the financial year ending with September, the total output was 598 tons, which is 122 tons below expectation.

AUSTRALASIA.—The North Cobar has been shut-down, only pumping being continued. A call of one penny per share is levied to meet debts in Australia.

During the first half of 1914 the North Broken Hill increased its output, raised its metal recovery, and decreased its cost; in each respect the improvement was slight but the cumulative effect is a record profit of £161,924 for the half-year. This was done despite lower metal prices, and reflects great credit on the management.

As we noted last month the gold produced in New Zealand is not being exported. As is the case with South Africa, Canada, and India, the gold is lodged in accredited banks, and the Bank of England gives credit to 97% of its value.

In a report to the Queensland Government, Mr. E. O. Marks, the assistant Government Geologist, comments upon the lack of cross-cutting in the Charters Towers district, and urges the more general use of this method of exploration underground. He advises such work in the older mines as more likely to prove profitable than the development of veins on the outskirts of the known gold-mining area.

UNITED STATES.—The Supreme Court has granted the application of the Minerals Separation company for the hearing of an appeal from the judgment of the Federal Court in the case of *Minerals Separation v. Hyde*. Therefore the litigation over the flotation patents is still *sub judice* and liable to further change.

CANADA.—The Le Roi No. 2 has secured options on the Giant and Californian claims

near Rossland and is to begin exploratory work forthwith, through the company's San José mine, which has three levels that have reached the Californian boundary.

RUSSIA.—Erection of plant for the Russo-Asiatic Corporation has been delayed by the war, but arrangements have been made for active construction as soon as normal conditions are resumed. A contract is about to be placed for the three large terminal stations for handling coal and ore at the Irtish river. The concentrate from the Ridder mill will be sent by rail to Ust Kamenogorsk, where it will be loaded upon barges for shipment down the river to Ermak. There the concentrate will be trans-shipped by rail to the smelters to be erected in the Ekibastus coal-field. Grading for this smelter is well under way.

At the Tanalyk the two stands of small acid-lined converters are in operation, pending the erection of the permanent converter plant. The power-station is nearly completed, a part of it being already in operation. Development of the mines is much hampered by scarcity of labour, due to the war, but, as far as they go, they are entirely satisfactory. Three promising prospects are being tested and a 150-ton cyanide plant is being erected to treat the gossan of the Semeonovsky mine, where over 150,000 tons of 10 dwt. stuff is already available. Cyanide is on its way from Glasgow. At the coal mine, 35 versts away, developments indicate an assurance of 500,000 tons of lignite available in one small basin. The narrow-gauge between the Mambet mine and the smelter is completed, except for ballast and one bridge. The line as far as Semeonovsky is already in use.

Kyshtim is doing a little better than the estimated production of 500 tons of blister copper per month. The large regenerative gas-fired reverberatory furnace has been started, but is not yet in full operation, by reason of the delay in completing the roasting-furnaces. The supply of labour is improving.

A big quartz vein carrying free gold has been found on the property of the Lena Gold-fields and is now being tested. The gold is accompanied by galena, and the prospects are encouraging. It may be one of the veins from which the placer gold of the Bodaibo was derived.

Further successful results have been obtained from bore-holes at the Sissert, the latest, No. 628 on Degtiarsky, proving the continuity of the orebody, with increased width. From 473 to 567 feet the core averaged 2'6% copper.

MEXICO.—The expected has happened. Carranza and Villa are now at war. Hostilities started after Carranza had refused to accept the provisional President nominated by a convention friendly to Villa. Meanwhile Carranza has flouted the United States and forfeited President Wilson's support. This new civil war ought to be of brief duration, for Carranza is no match for Villa in fighting ability. Under existing conditions the American government will be extremely loth to interfere.

The mill of the Esperanza Company, at El Oro, was idle from April 21 to August 31, owing to the political disorder. During that period the mine itself was operated by the Mexican staff, the output being accumulated at surface. As the company has a fair supply of cyanide, zinc, and other necessities, it is hoped to continue the operation of the mill, resumed on August 31.

INDIA.—In our notes last month we described developments in the Mysore mine "on the 13th level in Ribblesdale's section." We wrongly assumed that the reference was to the upper levels; as a matter of fact the work was being done on the 13th level in an auxiliary shaft below the main shaft in Ribblesdale's section, so that our inference that older parts of the mine were being prospected was incorrect. The two deepest mines in the Kolar district, the Ooregum and the Champion Reef

are giving excellent results in their lowest levels at present. In Bullen's section of the Ooregum, the 49th level is in ore 5 feet wide, averaging 18 dwt. per ton, and in Oakley's in the same mine the 52nd level is developing ore 2 feet wide, and averaging 25 dwt. In the Champion Reef, the 45th level in Glen's section is in ore averaging 2 ounces over 3 feet for 90 feet.

VARIOUS.—From a correspondent in South America we learn that Chile has forbidden the export of food-products. The majority of the nitrate works, or *oficinas*, have either shut-down completely or dismissed most of their employees. All Bolivian *peones* have been repatriated from Chile. It is reported that operations at Chuquicamata have been crippled by the fact that the orders for cement and machinery had been placed in Germany. A large number of workmen have been discharged. The Bolivian government has declared a moratorium and issued a decree that all storekeepers must sell imported food-stuffs at prices to be fixed by local authorities, furnishing a list of their stocks to such authorities. Infraction of this order is punishable by confiscation and fine. In most cases the price has been put down to bare cost, to the dismay of the importer. If he makes further imports, he is allowed to sell at a maximum profit of 12½%. All contracts for railway construction have been suspended and such work as is being done is performed by repatriated *peones* at a minimum living wage of 80 cents to 1 bolivar per diem. An effort to unite the discontented in a revolution was promptly suppressed, the disaffected being banished by the President, Dr. Ismail Montes. When the European war began, a number of the bigger mines suspended operations, but most of them have been re-started. As soon as the news of hostilities arrived, Montes called a meeting of the principal mine-managers to discuss steps to be taken to prevent a collapse of the industry. He arranged for the tin concentrate

or *barrilla* (presumably 60% of tin) and advanced 29 bolivars per quintal in paper currency, the *barrilla* to be stored for later disposal when the market re-opened and the balance—if any—to be paid to the mine. The President has proved himself a man of resource. All railway traffic is reduced. Local business is quiet and foreign business is entirely suspended. The shipment of *barrilla* to Liverpool can be made with an additional 4% insurance for war risk. Wages at the mines have generally been reduced from 30 to 50%. Unemployment is increasing. Freights, to and from the coast, have been reduced.

From Chosen (late Korea) we learn that the Seoul Mining Company is developing its Suan and Tul Mi-Chung properties with marked success. In adit No. 6 in the latter mine an orebody 80 feet wide, averaging 33 dwt. gold and 4½% copper has been disclosed. A dividend of 25% has just been declared.

The tin output of the Malay States in August decreased to 3591 tons, as against an average of 4200 during the previous 7 months.

The war has checked the progress of the Magadi Soda enterprise in British East Africa by interrupting the construction of the branch line to connect with the Uganda Railway. The entire local staff of the company has been enrolled in the defence force engaged in protecting this outpost of empire.

METALS.—The Metal Exchange was re-opened tentatively on Monday, November 9, with one hour's session daily, and under strict rules as to the nature of dealings. Copper prices have ranged from £51 to £55 per ton. A thousand tons of tin was lost when the *Emden* sunk the *Troilus*, and the consequent diminution of the visible supply caused a rise of £10 per ton in the price, which now stands at £139. The dull state of the galvanized iron trade causes a weakness in zinc, and the price remains about £24 per ton. Lead is firm at £18. Silver remains at 23d. per standard ounce.



EDITORIAL



“KEEP cool, and remember the Flag that flies over you.”

HERR KRUPP has received an honorary degree from the University of Bonn. This is a fitting recognition of the most effective expression of kultur.

COUNT BERNSTORFF, the German Ambassador to the United States, stated recently that Germany has “a right to land troops in Canada, if possible.” Again that curious lack of humour. Germany has the ‘right’—the autobiographical right—to place troops in Paris, Petrograd, and London. So far her troops have found a precarious footing only in Belgium.

THE steamer *Candidate* was the first vessel to reach Liverpool by way of the Panama Canal. She left Seattle on August 22 and arrived in the Mersey on October 15. On the day previous a big landslide in the Culebra Cut blocked further traffic through the Canal. All the available dredges have been put to work to clear the waterway which will shortly be re-opened for traffic.

CASUALTIES to shipping have not been without immediate interest to the miner. The *Bruno*, sunk by a mine in September, carried hoisting and pumping machinery, as well as converter parts, for the Ridder, Tanalyk, and Kyshtim companies in Siberia. The *Clan Grant*, sunk by the *Emden*, in October, carried machinery and supplies for the mines in the Kolar district of India, while

the *Troilus*, also sunk by the enterprising *Emden*, had a cargo that included shipments of tin from the Straits Settlements.

AMONG the donations to the National Relief Fund on October 31 was £2000 each from Mr. W. F. Langshaw, of New Bedford, Mass., U.S.A., and Mrs. Harriet Fletcher, of Boston. We are not surprised, but we are nevertheless touched by this expression of good-will from Massachusetts.

USE of codes during the war is now permitted by the Post-Office authorities, but facilities are limited to four recognized codes, among which one special to the business of mining is not included. We are glad to learn that an appeal has been made to the Postmaster-General asking him to sanction the use of the code usually employed in mining: the McNeill.

COMMODORE TYRWHITT understands the use of words. In describing an episode in the fight off Heligoland he says: “We received very severe and almost accurate fire from this cruiser.” The Commodore appreciates the fact that “almost accurate” is no better than “inaccurate,” and that “a miss is as good as a mile.”

IN this issue we are fortunate in being able to publish an article on the Kent coalfield by Mr. E. B. Lichtenberg, A.R.S.M. He made an investigation of this coal region during the past summer and would have given us the article for publication in August if the war

had not supervened. Owing also to this circumstance he has not gone into detail, leaving that for a time when peaceful industry will again engage our undivided attention. Mr. Lichtenberg, besides a general training in mining, has had special experience in the exploitation of coal, in South Wales, South Africa, and Canada. Coming from one that is not only thoroughly qualified but also entirely independent, this account of coal enterprise in Kent will be much appreciated. We regret only that an exploitation fraught with so much possibility for usefulness has not, as yet, proved successful.

VICISSITUDES are a part of journalism, but a newspaper has rarely been driven from pillar to post to such an extent as *L'Indépendance Belge*, which began to be published on British soil on October 2. Driven in turn from Brussels to Ghent, and then to Ostend, this famous journal exemplifies the unquenchable spirit of the Belgian people. We welcome *L'Indépendance* to England, and trust that it may find comfortable quarters here until that day of liberation when the Germans have been driven back and the unhappy Belgians are restored to their homes.

ON the 19th instant the Institution is to have its first meeting of the current session, the paper for discussion being one upon 'Persistence of Ore in Depth' by Mr. T. A. Rickard. It is probable that the general interest of the subject will elicit valuable comment.

AT the St. John del Rey mine, in Brazil, many of the English employees applied for leave to answer their country's call. The manager, Mr. George Chalmers, decided to take the names of those who had undergone some military training. Thirty came forward, and out of these 10 were selected to be

sent to England, the company agreeing to allow them during absence one-third their customary pay. Three members of the staff had belonged to the Officers Training Corps, namely, Messrs. E. G. Morris, J. W. P. Chalmers, and G. M. Austin. The other seven on the list of honour are W. Camplin, B. Clements, J. Haswell, F. Rhodes, J. Richards, R. Smith, and S. Treloar. A large number of men still at the mine are anxious to go to the front and are practising at the rifle-butts. The staff has united in making a monthly contribution of £157 17s., while the war lasts, to the Relief Fund. Truly the St. John del Rey has done nobly. In Egypt the staff of the Sudan Gold Field Company has started a subscription for the Relief Fund. Every man on the mine has pledged a day's pay per month for the duration of the war, and even the Greeks and Arabs have come forward on their own initiative.

FULLY one half of the students of the engineering colleges in Great Britain have enlisted or have already gone on active service. The new building that worthily houses the Royal School of Mines at South Kensington has a deserted appearance. The numbers attending the fourth year's mining class have shrunk from 42 to 11, and of the latter, three are Russians who have been transferred from the Liège mining school, and two are Japanese. There are only 23 freshmen for the mining course, instead of 70 as expected. Of the teaching staff, Messrs. W. H. Merrett, Bernard Holman, and C. L. Courtman are giving military services to the country. Mr. C. O. Bannister, lately of the Sir John Cass Institute, is taking Professor Merrett's lectures. Several engineers of mature experience have recently joined the staff as demonstrators: Mr. Alexander Richardson in the survey department, Mr. Arthur Yates in concentration, and Mr. H. Stadler in milling. Mr. Richardson was for some years

engineer with the Anglo-French Exploration Company, and has only recently retired from the presidency of the Chemical, Metallurgical, and Mining Society of South Africa; Mr. Yates has an excellent record in Sumatra and elsewhere; while Mr. Stadler's researches and theories relating to crushing and sizing are well known. It is opportune that the staff should be strengthened in this way at the present time, for on the conclusion of the war, the returning students are to be given facilities for completing their courses as rapidly as possible.

GENERAL BOTHA is both Commander-in-Chief and Prime Minister of the Union of South Africa. The nearest analogy is that of the Duke of Wellington, who, however, did not become Premier until he had retired from active service. But to General Botha belongs an achievement that needs no analogy. He opposed Kruger when that President of the Transvaal was planning war against England, but, once war was declared, he devoted all his energies to the cause of his people. As the general commanding the forces against us in the Boer war, we learned to respect him as a brave and chivalrous opponent. Shortly after peace had been signed, the Liberal party restored self-government to the Boer provinces and approved the subsequent federation of states in the Union of South Africa. General Botha retained his leadership, becoming first Premier of the Transvaal and then Premier of the Union. Now, he has united the two races, the Boer and the Briton, in the defence of South Africa, against German aggression, and won the support of the entire Union of South Africa, now a union not in name alone but in a common tradition of political integrity.

HAIL to the children of the Empire that have heard the call of the blood! A machine-gun corps is coming from the Yukon.

It is composed of South African veterans and has been financed by Mr. J. W. Boyle. To go from Dawson to Boulogne they will travel 10,000 miles. When war was declared, Neill Macdonald was on Hudson's Bay. The news came by wireless. He made a 23 days' journey, by canoe and portage, to Ottawa, and is now in training on Salisbury plain. Eighty picked men have come from the Argentine. Shanghai is sending a contingent. These are some of the inconsiderable but not unconsidered contributions of the greatest of all war material—brave and capable men. When the Canadian, Australian, New Zealand, Indian, Newfoundland, Rhodesian, South African, and the various other contingents are arrayed in battle for the Union Jack we shall see whether the Empire is played out, as the Enemy claims, or whether the bonds of blood and liberty (not iron) are so strong that the sword has not been forged that can sever them.

Financial Conditions.

When the historian of the future comes to the year 1914 he will doubtless indulge in a good many profound generalizations that we of this generation will do well not to anticipate in any detail. Nevertheless, it is already evident that we are witnessing the close of an epoch. Everyone who thinks at all is conscious that his opinions on many matters of the deepest import are not what they were six months ago, and he would be a bold man who endeavoured to predict what the social philosophers, and, what is more important, the democracies of Europe, will be saying and thinking twelve months hence. Among the numerous reactions of the war on social policy none is more suggestive than the attitude that the State has been compelled to assume toward individual enterprise. The Government has already gone into the bill-discounting business on a huge scale, taken over the management of the railways, effected the greatest purchases of sugar on record, and yet it is prob-

ably only at the beginning of its activities. The last fortnight has seen the promulgation of a scheme of Stock Exchange relief, which it is hoped will unravel the complicated tangle into which the business of that institution had become involved. Not many weeks ago any such project would have been scouted by the man in the street as unthinkable. Today the principle escapes criticism because everyone recognizes that some form of State help is the only method by which a catastrophe of the first order can be avoided. The broad outlines of the scheme are already familiar to those of our readers who take an interest in financial matters. The Treasury has arranged with those banks to which currency facilities are open not to press for repayment or require the deposit of further margin until 12 months after peace, or after the expiry of the Courts Emergency Act, whichever shall happen first, provided interest at an arranged rate be duly paid. It has also arranged with lenders that they can obtain from the Bank of England an advance of 60% of the value of the securities held by them, such value to be calculated on the basis of the make-up prices of July 27. In other words, Stock Exchange borrowers will not be pressed for repayment on fresh margins provided they pay their interest regularly, and, in order to prevent hardship to lenders arising from non-payment, they can obtain an advance of 60% of the value of their securities, which is probably equivalent on an average to 70% of the value of the original loan. The scheme is primarily confined to account-to-account loans made to members of the Stock Exchange, but does not apply to lenders who are members of the Stock Exchange. The scope, therefore, is somewhat severely limited. *Prima facie* there seems no reason why the Stock Exchange borrowers should be specially favoured, and, in fact, efforts were made to induce the Treasury to extend the benefits of the proclamation to other borrowers against securities. Theoretically

the case for this being done was a strong one. The mining finance houses, for example, are just as hard hit as the Stock Exchange, and the functions they fulfil toward industry are far more direct, and, at least, as useful. Normally they are both borrowers and lenders on securities, and any argument that could be urged on behalf of the Stock Exchange could be pleaded in their favour with equal force. In practice, however, the reply of the Treasury was unanswerable. The only justification for any steps being taken was that otherwise failures on a scale that would involve not only brokers but the banks and the whole machinery of credit were inevitable. It was incumbent on the State to take only the minimum risks necessary to guard against such a catastrophe. Moreover, such risks must obviously be limited in amount, otherwise the credit of the State itself might suffer, in which case the remedy would give rise to consequences infinitely worse than the disease itself. A guarantee of all loans against securities would have been indefinite in amount, whereas the loans that are affected by the proclamation are a known quantity, being slightly under £80,000,000. Having regard to the fact that the securities are in normal times worth far more than that amount and that recourse will be had against both borrowers and lenders before loss is incurred to the State, the actual ultimate risk is negligible while the measure of relief is great. Moreover, the position of the outside borrower is probably better in reality than in appearance. It must not be forgotten that the great lending institutions, the banks, are under considerable obligation to the Treasury, which, since the outbreak of war, has assisted them by increasing currency facilities. Although it does not appear on the face of the proclamation, it is none the less the fact that an understanding exists between the State and the banks, that the latter shall not press their customers for increase of margins or for re-

payment during the war, and for a reasonable period thereafter. On the whole, the banks appear to have acted within the spirit of that understanding, although recently cases have been reported of pressure being put upon outside customers, on the ground that Stock Exchange loans have been hung up for an indefinite period, and, therefore, other borrowers must make a special effort to repay. The *sequitur* is not obvious, and probably the attempt is not expected to succeed. The fear in the background that the Treasury might have something to say if matters were pushed too far, the impossibility of realizing securities, the operation of the Debtors Emergency Act, and, above all, the promptings of enlightened self-interest, which must tend in the direction of keeping the customer 'in being,' all combine to enforce a policy of leniency. It is only fair to add that although our joint-stock banks are privately-owned institutions formed for purposes of profit, in the great majority of cases they have in this shattering crisis, shown themselves alive to a sense of their public responsibility. It is of high importance to many industries—and to none more than metalliferous mining, which largely lives on borrowed money—not only that the banks should not precipitate a catastrophe by pressure, but that where legitimate enterprise is concerned, borrowing facilities should not be unduly restricted. The banks have made huge profits from the public in the past, and at this crisis, when the whole credit system of which they are an integral part is at stake, they must be prepared to take a statesmanlike view of their duties. Within fairly obvious limits it may be the truest wisdom to run risks that in happier times would be deemed uncommercial.

To a large section of the public the most interesting portion of the Treasury scheme is the Emergency Rules that the Stock Exchange Committee has issued to give effect to it. These will regulate the settlement,

which it is now understood will be held on November 18. With the operation of these regulations as between members and members it is not necessary here to deal. The subject has given rise to interminable discussions, which for a time almost galvanized Throgmorton Street into a fugitive appearance of life. Needless to say, the proposals have aroused considerable criticism, the volume of which appears to be increasing as they are more closely scrutinized. It could hardly be otherwise. Members have plenty of time on their hands, and criticism is an exercise that need not involve intellectual effort of a fatiguing character. In this case criticism, especially of details, is particularly easy. The difficulties of any scheme were immense, and so many interests are at stake that it is almost impossible to obtain from any member of the Exchange an opinion that is not hopelessly coloured by personal considerations. Viewing the proposals broadly, we are inclined to think that a dispassionate judgment on the work of the Committee would be favourable. There are gaps, of course; many circumstances have not been foreseen; and certain classes of transactions, notably those dated between the last settlement and the closing of the Stock Exchange, appear to have been overlooked. But all these can, and no doubt will, be regulated later. There are anomalies. Holders of some classes of shares are better treated than others, and many cases of hardship will arise inevitably. The circumstances, however, are so unprecedented and the tangle so complicated that an ideally satisfactory settlement is impossible. On the whole, the regulations do appear to have the great merit of representing an honest attempt to extend the benefits of the Treasury proclamation to all borrowers from account to account, whether they be members of the Exchange or of the public; and it was precisely here that they might have been expected to break down. Hitherto the Stock Exchange Committee has

enjoyed the reputation of being more anxious to protect the interests of members than of the public on which they live. In this regard, however, no exception can be taken to the regulations. Clients who 'carried over' stock last July can do one of three things in order to secure the continuation of their bargains for a year after the conclusion of peace: they can deposit with the broker cash to the value of 10% (or in the case of trustee securities 5%) of the total amount of their stock calculated on the basis of the last make-up price on July 27, or they can deposit securities that had that value on that date. In either case they must pay interest fortnightly at rates to be fixed by the Committee from time to time. There is apparently—although the regulations are not explicit on the point—a third course open to the borrower, namely, that of depositing no margin in cash on security but of paying "a reasonably higher rate" of interest in lieu of margin. If during the continuance of this enforced carry-over the stock reaches the price at which it stood on July 27, it is open to the lender to close the transaction. Such, broadly, is the position as it affects the client, and it cannot be said that it is unfair or ungenerous. If a purchaser for the account cannot provide a margin in cash on security that circulated on the July basis of 10%, he would not be entitled to much consideration in ordinary times, and would certainly receive none. Unfortunately, however, this margin cannot now be provided in some cases, particularly where brokers were dealing for continental clients. The man who acted as agent for purchasers in Antwerp, Liège, Lille, or many other once prosperous towns, has no practical recourse, and as for the German clients—a numerous class—payment will in the majority of instances never be made. Certain brokers with a foreign connection may well be unable to find a 10% margin, and a proportion of clients who under normal conditions can face a normal loss may

have been so far weakened by the heavy fall prior to the end-July account as to be in similar case. So strongly is this felt that it is not improbable that the regulations will be still further relaxed; but it must be remembered that if ever the account is to be liquidated, and the Stock Exchange re-opened, a beginning must be made, and some proportion of the liability discharged. The Committee would have done well to provide for the deposit of the margin by instalments. Something of the kind appears to be contemplated, but the regulations are not explicit on this point. The deposit of securities in lieu of cash may cause difficulties. All securities have to be taken at their value at the July make-up, and the obvious temptation will be to purchase and deposit the securities that show the largest relative decline since that date. On this and other points the regulations are studiously and wisely vague. The Committee evidently realizes that the intricate tangle can only be straightened with infinite care; it announces that any difficulty can be referred to it for decision, and that the regulations will be interpreted in a liberal spirit, with the object of rendering the next settlement "as easy as possible."

Easy it cannot be, but if ever it is to be adjusted at all, a beginning must be made. The regulations as a whole are conceived in the right spirit and admit of a great deal of elasticity. It is "a long long way" from the next settlement to the re-opening of the Exchange, for which the consent of the Treasury will be required, and it is difficult at this stage even to conjecture when that will be possible. The settlement itself will clear the air to some extent and allow the position to be viewed in a clearer light, but so far as can be seen it is hardly likely that the House will be re-opened for dealings during 1914, unless the war takes a more definitely favourable turn than seems probable. It is, however, of great importance to the country as a whole that the greatest

bourse in the world should start business at the earliest possible moment compatible with safety. It is today more evident than ever before that modern business and the free exchange of the scraps of paper representing wealth are interdependent; and it would seem that even the speculator from account to account is an essential factor in the intricate machinery of industry. Assuredly if he were permanently eliminated, metal mining would be one of the first industries to suffer, and it is not the least curious feature of this amazing situation that so many huge interests have been forced to realize that the disappearance of the speculator would necessarily be followed by a collapse, the effects of which all the efforts of this generation would not suffice to undo. There is little doubt that the regulations will be expanded, and it is probable that they will be modified in the direction of tempering the wind to the shorn bull still further. It is even possible that the settlement fixed for November 18 may be postponed to allow the necessary alterations to be made, but the broad principles are fixed, and, given a measure of goodwill on the part of everybody concerned, they seem calculated to make the best of a bad business.

Kultur.

We spell it in the German way, for it has ceased to be synonymous with the similar word in the English language. To those who have read the literature of German megalomania or watched the recent effort to put that literature into action, the word kultur suggests neither the evolution of the human intelligence nor the development of scientific research, but ethical nihilism and the systematic organization of manifold murder for the purpose of winning a larger share of material prosperity. The aim of culture is the uplifting of the human spirit; the purpose of kultur is the aggrandisement of a tribe. The one is catholic in its scope, the other is provincial in its

insolence. Such men as Göthe and Schiller, Kant and Hegel, Schubert and Beethoven, are a part of the spiritual and intellectual inheritance of mankind; they laboured not for the glorification of the Teuton but for the widening of the human horizon. That has ever been the unconscious aim of true culture. In its stead the Prussian now gives us an apotheosis of self-esteem, expressing itself in a deliberate effort to fasten the goose-step on European civilization. We have seen its effects on the leaders of German thought. The manifesto of the "representatives of science and art" was published recently in the *Berliner Tageblatt*. These exponents of kultur assert that France and Britain violated the neutrality of Belgium before Germany did so, as if their saying so could alter a patent fact to the contrary. They insist that Germany is the victim of aggression, in the face of their impudent books, from Bernhardi to Frobenius, explaining the inevitableness of the war and the manner in which they plan to destroy their enemies seriatim. They point to the Kaiser as a devotee of peace, when their own White Book says: "We were perfectly aware that a warlike attitude on the part of Austria toward Servia might bring Russia into the field, and that it might therefore involve us in a war." Moreover, the concrete emplacements for the big howitzers were prepared by the Germans in France, by stealth and fraud, months before the declaration of war. They ask us to believe—these representatives of kultur—that the destruction of Louvain was a reprisal taken "with heavy hearts" against a "furious population," and they ask the world to look upon the conduct of the war in Belgium as the "bitterest necessity for self-defence." They ignore Herr Von Bethmann Hollweg's frank avowal in the Reichstag that a "wrong" had been done, but they follow his lead in contending that the Prussian was compelled by necessity "to hack his way" through Belgium. It was the same 'necessity' that impelled Bis-

marck to strengthen the text of the Ems despatch, and so, by fraud, to hasten the war of 1870, according to his own confession as embodied in his memoirs. These professors and doctors claim that "militarism has gone out in defence of kultur, in defence of the land which has for decades proved such a home for art as it will never enjoy anywhere else." Again the characteristic note. These disciples of intelligent brutality argue like sophomores in a provincial college, as if France and Italy, Poland and Belgium, for example, had failed to furnish "a home for art" during all the decades during which the German was sharpening the sword for aggressive warfare, and for centuries before Germany existed as a nation. True culture is not forced on mankind by howitzers and Death's Head hussars. And so the manifesto ends with the asseveration: "The German army and the German people are one." Yes, for a time every German must be a Prussian, but we trust that ere the bloody drama is over it will be plain who is the villain of the piece. When the nightmare of Pan-Germanism has passed in the dawn of a better day and the orgy of Prussian militarism has been ended as it began, with the sword, we shall see that the military fanatics over-fed by partisan historians could have done little for brute force if they had not won the support and favour of a crowned braggart, Wilhelm of Hohenzollern, who claims partnership with the Almighty in his fell designs for European hegemony.

Shakespeare says that "a man that hath no music in himself is fit for treason, stratagem, and spoils." We would substitute humour in place of music. The lack of it has proved a fatal defect in many men, and in some peoples, notably, at this period, the German. We quote herewith a passage from a recent issue of the *Kölnische Zeitung*.

"Europe has but one arch-enemy, and that is Great Britain. This enemy that gnaws at Europe's real culture, must be

crushed, utterly annihilated with blood and with iron. And the day of the British enemy's destruction is close at hand, for his annihilation is threatened not only by the outraged arm of Germany, but also by India, Egypt, and Turkey, possibly also by a conflict with the United States over the burning questions of Canada and Japan. The British people is capable of being instructed, through sound chastisement. And when once its education has been completed on a true German basis, that people will no longer be the enemy of Europe, but our natural friend."

In brief, the protagonists of "real culture" are going to "utterly annihilate" Great Britain as a preliminary to "educating" her, and, having "soundly chastised" our country, they expect her to become a "natural friend." Moreover, the "outraged arm of Germany" is to be strengthened by a strange assortment of assistants, including India and Egypt, not to mention that most excellent fellow, Uncle Sam. The absurdity of it all is hidden from the perverted intelligence that edits so important a newspaper as the *Kölnische Zeitung*. It would all be deliciously funny, if it were not tragically portentous. As we listen to the vapourings of the War-Lord at Potsdam we need not ask:

"Upon what meat doth this our Cæsar feed
That he has grown so great?"

For this is the sort of pabulum that has sustained his paranoia for many years. The teaching of Treitschke, Clausewitz, Harnack, and that perverted sentimentalist Chamberlain, has been supplemented by a gang of journalists that pandered to Prussian conceit under the leadership of such men as Professor Schiemann and Count Reventlow. Moreover, the idea that kultur was the only condiment for an unsavoury world has gained no inconsiderable dignity at the hands of those American professors that, on the Kaiser's initiative, have been invited to lecture at Ber-

lin, and by the German professors that, in exchange, went to the American universities to give light to the supposed heathen on the other side of the Atlantic. It became almost a fashion in certain circles to regard the Kaiser as an international Mæcenas and to accept his envoys as missionaries of a new religion. The boorishness of some of them and the insolence of others did sometimes stultify their mission, it is true; and the Kaiser's vagaries tended to throw occasional doubt on his real relationship to the Deity. Indeed, the American sense of humour was bound to protect them from a gross imposition. Since then the moral astigmatism of the Prussian has been laid so bare that even the ample mask of learning no longer suffices.

Students of science, such as the members of the mining engineering profession, are not ungrateful to German research, in geology and chemistry, for example, but their reasonable appreciation of Germany's share in the development of the arts of mining and metallurgy does not blind them to the fact that that share is not preponderating. The record shows that France, England, and America have each done more during the last century, which is the period of maximum progress in all that concerns the miner. In these matters, as in those of broader culture, the German exhibits mechanical intelligence without psychical intuition. He compiles laborious masses of information but overlooks the vital points. Consider the German system of espionage—during time of peace—with its mean elaboration and pitiful misinformation. In the same way the strenuous effort in the equipment and organization of war is coupled with a childish misunderstanding of political conditions outside their own borders. They thought the French armies could not fight, while the glorious military record of France stared them in the face. They misread England's past, and failed to understand her quiet strength. They underestimated the pluck of the Belgian and forgot

the proverbial stubbornness of the Russian. They wrapped themselves in vainglory and called it patriotism. From the Kaiser to the gutter-press scribbler they are steeped in a national obsession as to their mission on earth. Kultur in Germany has become synonymous with the creed of conceit preached by historians that perverted the facts of history to fit a preconceived notion that the Prussian was the salt of the earth, without which life on this globe would lose its savour; kultur is the gospel of Krupp and the other armament manufacturers that expected to take toll of human life; above all kultur is the literature of the devil that has driven a great people to a world catastrophe.

Since the war began many of us have dipped into the literature of pan-Germanism to find its sinister megalomania unrelieved by one kindly sentiment or softened by one generous expression; throughout it is saturated with passionate greed for Germany alone, wrapped in pestilential contempt for all the world outside. Truly it is the gospel of the swelled head, pitiful in its origin, tragic in its consequence. It is piracy articulate. Treitschke, unable to perform military service on account of his deafness, exclaims enviously: "Each dragoon who knocks a Croat on the head does more for the German cause than the finest political brain that ever wielded a trenchant pen." Says Bernhardt: "Might is at once the supreme right, and the dispute as to what is right is decided by the arbitrament of war. War gives a biologically just decision, since its decisions rest on the very nature of things." The Kaiser, in bidding farewell to his troops about to go to China in 1900, said: "When you come into contact with the enemy, strike him down. Quarter is not to be given. Prisoners are not to be made. Whoever falls into your hands, is into your hands delivered. Just as a thousand years ago the Huns, under their King Attila, made for themselves a name which still appears im-

posing in tradition, so may the name of German become known in China in such a way that never again will a Chinaman dare to look askance at a German. The blessing of the Lord be with you." The conclusion must have rocked Hell with laughter. This desire to make a "name imposing in tradition" is still evident. Up-to-date kultur is evinced by the proclamation of the German staff in Belgium, announcing that "the only means of preventing surprise attacks from the civilian population has been to interpose with unrelenting severity and to create examples which by their frightfulness would be a warning to the country." Yes, they have been "created" at Louvain, Aerschot, Termonde, and other scenes of horror where the unfortunate civilian population has been the victim of "surprise attacks" from an enemy against whom no quarrel existed except that they occupied a small corner of the map. 'Kultur' is what the ravens croak as they fly amid the ruined arches of Louvain; 'kultur' the buzzards scream as they batten on the putrefying harvest of the battle-field; 'kultur' shriek the fiends with laughter echoing down the corridors of Hell.

Camp Bird—Santa Gertrudis.

At the close of the Santa Gertrudis meeting, Mr. H. C. Hoover stated that the assets of Mr. A. M. Grenfell and the Canadian Agency amounted to £33,000 as against liabilities exceeding £3,000,000. Naturally this failure, made known early in June, has thrown its sinister shadow across the fortunes of the Camp Bird company and its Mexican subsidiary. When Mr. Grenfell's bankruptcy was known to be impending, a number of the larger shareholders asked Mr. Hoover to take the chairmanship, and subsequently in conference with them it was decided to invite Messrs. F. A. Govett, F. H. Hamilton, and G. de Pass to join the board in the places of the two Grenfell brothers, Mr. J. S. P. Sam-

borne, and Mr. R. J. Frecheville. As soon as the new board was organized, a technical committee was formed and on that committee Mr. Frecheville was asked to serve as chairman. Of the old board, omitting the two French directors, Messrs. L. Clerc and O. de Rivaud, both of whom, by the way, are serving in the French army, only Mr. F. W. Baker remains. After Mr. Hoover, as chairman, had indicated the nature of the losses inflicted on the Camp Bird company and its subsidiaries through the financial collapse of Mr. Grenfell and his associates, it was not surprising that several shareholders expressed their indignation at the mismanagement of their affairs and turned to attack the surviving member of the old board. Mr. Baker replied at once, in a manner both disarming and convincing. He spoke of his trust in Mr. Grenfell, with whom he had collaborated for 14 years. Undoubtedly 18 months ago Mr. Grenfell was a rich man, his financial position was undeniably strong, and his reputation was in the ascendant. The first inkling of something wrong came to Mr. Baker when he called at the office of the Canadian Agency for a cheque on account of shipments of silver from the Santa Gertrudis. There had been rumours. This attempt to postpone settlement was more than suggestive. Mr. Baker refused to leave the room until he obtained payment, and immediately thereafter he took steps to protect the company's interests. Thereby he had saved £200,000. This he said with a frank willingness to accept such blame as the shareholders might still debit to his account. Obviously, we suggest, it was a case where one man had been misled by another and it was left for any third man to assert that he would have been wiser. With an exhibition of generosity and good sense that does them credit, the shareholders accepted the explanation, and, in effect, exonerated Mr. Baker. In our opinion it was fit and proper that the criticism and the protest should have

been made; and it was also fit and proper that the explanation should have been accepted in the friendly spirit manifested by the meeting. Our own criticisms of the past management of the company's affairs are recorded in print. From the first Mr. Grenfell ran the business too much as an annex to his Canadian Agency; he and other directors under-wrote issues of common shares, preferred shares, and debentures in a manner that may have been helpful but certainly complicated their position as trustees for the shareholders; one director, Mr. W. F. Fisher, resigned because he was out of sympathy with these doings; moreover, the Santa Gertrudis deal included a preposterous commission of £120,000 to Mr. Hammond, who at that time was also in receipt of a salary of £4000 as consulting engineer to the Camp Bird company. These matters were criticized frankly by us at the time and we marvel now how docile the shareholders and the financial Press then proved themselves to be. The débâcle of last June was a logical sequel to such methods of joint-stock finance. Now, a complete change of administration has been made in London; the management of the mines themselves has been excellent, as was acknowledged gladly by the new chairman. As to actual operations, the old mine in Colorado has continued to show surprising vitality and by its productiveness has made compensation for the interruption of returns at Pachuca. During the past year the Camp Bird yielded a profit of £70,292, and a further profit of £63,000 is estimated for the current year, after which, unless unexpected discoveries are made, the life of the mine will be at an end. A short run of ore has been found on the 8th level, but prospects in depth are poor, as they have always been. If any new resources are uncovered, it is likely, in our opinion, to be in the upper workings. Mr. Hoover is to visit the mine shortly, and will be able to make an authoritative appraisal of its further capabilities.

At the Santa Gertrudis the main vein has been followed down to the 20th level, which is 1850 feet in vertical depth. In these bottom workings only two short ore-shoots have been found, the results as a whole being decidedly disappointing. Further development is to be extended 400 feet deeper in the hope of improvement. This impoverishment in depth is a contingency that was lightly regarded in the appraisal of the mine at the time of purchase, as was suggested in these columns long ago. Financial participation in schemes of promotion is unlikely to sharpen an engineer's critical faculties as regards the mine that is the object of that promotion. However, the Santa Gertrudis is affording evidence of favourable lateral developments. Several orebodies have been found on parallel veins easily explored by means of cross-cuts from the existing levels. We agree with the statement that the possibilities of further development on such parallel veins are highly encouraging. We also believe that the interests of the Camp Bird company, and its subsidiaries, are now in good hands. Mr. Govett brings to bear an experience that should prove invaluable and he also brings a reputation for square dealing that cannot but prove a source of strength. Mr. Hamilton is a man of high character and proved sagacity, with a wide range of experience in mining affairs. Mr. de Pass is one of the largest shareholders and therefore well able to protect the interests of *all* the shareholders. The new board has started well in one respect, at least. No keenness of observation was needed to discern the fact that the recent meeting was a real assembly of the proprietary; no attempt was made to check free discussion; nobody had been primed to drag a red herring across the trail of financial misdoing; it was all genuine, from the chairman's straightforward talk to the criticism from the floor of the hall, and the replies thereto. No less sincere was the courtesy with which an unofficial shareholder put the motion

that elected the new directors. We hope that all future meetings may be conducted in the same spirit, and that they may be brightened by a gratifying record of accomplishment.

South Africa and The Empire.

In our last issue we concluded some remarks on German South-West Africa with the suggestion that "some picturesque incidents are assured." A few days after these words had been printed, the Governor-General of the Union of South Africa sent a despatch to the Secretary of State for the Colonies, telling the story of a German attempt to raise a rebellion by aid of Colonel Maritz, the officer in command of the Union forces in the north-west of the Cape province. This recalcitrant Boer, with most of his force, went over to the enemy; he also had the impudence on October 8 to send an ultimatum to the Government threatening to invade the Union unless sundry Boer leaders were permitted to meet him near Upington, on the Orange river. Maritz had some German guns and held the rank of general over the German troops attached to his command. Moreover, he exhibited an agreement whereby the Governor of the German colony promised to guarantee the independence of South Africa as a republic, while Maritz promised to cede Walfish Bay and other portions of Union territory. The reply of the Government was prompt; martial law was proclaimed on October 12, General Botha placed himself at the head of the Union army, and an expeditionary force was despatched to the frontier. On October 25 Maritz and his commando were defeated by a force under Colonel Brits at Kakamas, and the conspirator fled, wounded, into German territory. Various parties of rebels surrendered at intervals thereafter. Then, on October 28, when the menace of rebellion seemed to have passed, came the startling news that General Christian De Wet and General Beyers were organizing a revolt against the Union government in the northern Free State

and the western Transvaal. Overt acts of hostility had already been committed, a train had been stopped, and the town of Heilbron had been seized. De Wet and Beyers were among the men on whom Maritz had counted, but there is no evidence that they intended to co-operate with him. This new development, however, looked sinister; it appears that De Wet and Beyers objected to an offensive campaign against the Germans in South-West Africa, but that, of course, committed them to the German cause, as their own military experience should have taught them. General Botha instantly led a strong force into the western Transvaal and scattered the rebels under Beyers. Many of his followers were captured on October 29. It soon became clear that South Africa as a whole rallied to the support of General Botha and the Government of the Union. The small group of irreconcilables found some backing among the *bywoners* of the back veldt, but the better class of Boers are ashamed at the bad faith of these former leaders, who have dishonoured the names that they had signed to the treaty of Vereeniging. The revolt is more against the Botha government than against the Flag. As the *New York World* says, "it is a minority Boer revolt against the Boer government of a loyal British colony." This is no fulfilment of Bernhardt's dream. Some of the more stubborn Boers of the old school have viewed General Botha's frank acceptance of British liberality with suspicion, while others have seen their political ambitions frustrated by the continued dominance of General Botha and his staunch comrade, General Smuts. Moreover, the futile outbreak of De Wet, Beyers, Kemp, and Claasen is ascribed, in part, to the vaticinations of a religious maniac, named Van Rensburg, in the Lichtenburg district. Delarey is said to have been impressed by him. He must be a local Treitschke. Some reason not visible to the naked eye must have prompted men previously sane and courageous to be

so unwise and so dishonourable. Whatever the cause, the effect is inconsiderable as regards permanent harm. The followers of Beyers have been dispersed, and are being captured in small groups, with but little fighting. De Wet has made speeches that indicate something like mental derangement. He is still at large, but his following is small and poorly equipped. They are collected in the northern part of the Free State, to which adequate Union forces have been sent. The insurrectionary movement has failed entirely. The Dutch population has refused to be misled. The chief result is to place Boer and Briton in comradeship of arms under the Flag.

Copper.

In our last two issues we have discussed at some length the effect of the war on the production and distribution of the metals more particularly as they affect the interests of the British Empire. We have shown that the closing of the German and Belgian smelters has temporarily stopped our producers of zinc ore, and inconvenienced the mines yielding lead ore. It is opportune now to consider the position of copper. Here we find the circumstances to be entirely different, for, with the exception of some of the Australian mines, the selling contracts for disposal of the output have not been in the hands of Continental merchants. The fact is that Germany has never been an important producer of copper, nor have her metallurgists won renown in this branch of technology. Economic conditions have not been such as to encourage the import of copper ore or matte into Germany. If her industrial development had commenced earlier, she might have entered into effective competition with Swansea, but by the time that period arrived, the metallurgy of copper had been developed elsewhere, more particularly in America, and the opportunity of founding an import trade in oxidized ore or sulphide concentrate had gone. To a small extent Ger-

man capital has been applied abroad to the development of mines, either directly or through English companies, and we may instance the Siemens group of electrical engineers as having large share-holdings in London. Some of the Spanish mines are under German control, and supplies of matte have also been obtained from Damaraland. But it is as a purchaser of refined metal that Germany has secured so important a position in the copper market, for she is only second to the United States as a consumer. The figures for 1913 show that her consumption was 250,000 tons, as compared with 340,000 tons in the United States. Of her consumption about 25,000 tons was produced at the Mansfeld and Rammelsberg mines in the Harz, and 15,000 tons from imported ore and matte. Of the other 210,000 tons imported, 190,000 tons came as refined metal from the United States. As copper is contraband of war, no shipments are now being made direct from the United States to Germany; but it is being shipped by German agents at New York to German buyers at Rotterdam, the product of a neutral country being delivered in neutral ships to a neutral port. The amount shipped in this way during September was 5500 tons. Guarantees are supposed to be given that the copper is required for Dutch consumption, and that none is re-exported to Germany. As the consumption in Holland is not more than 1000 tons per year, according to the Metallgesellschaft, of Frankfurt am Main, the American customs authorities could, if they wished, gauge the genuineness of the guarantee. With its own production and with the imports through Holland, Germany is well supplied for all her requirements in connection with the war. Moreover, large accumulations of concealed stocks are probably available. A year or two ago the American producers became suspicious that the purchases for Germany were greater than the current requirements demanded, and they interpreted the movement as a factor in the

German plan to control the copper market still further. In the light of recent events, another explanation suggests itself.

The above is briefly the position of the copper industry in relation to the war. The occasion is opportune for a review of the chief historical aspects in connection with the production and use of the metal. It is the most ancient of the metals as adapted to the requirements of man, and in the form of bronze was in ancient times the leading metal used in warfare and industry. Later it was replaced by iron and steel. With the invention of the steam-engine, and the general advance of mechanical science, came the first big expansion, during the earlier part of the nineteenth century. The second commenced about 1890 when electrical work created a demand so great that at the present time three quarters of the world's production is used for this purpose. In glancing through old records, we find that Saxon and Swedish mines were at work 600 years ago, some of which, notably the Mansfeld and those belonging to the Stora Kopparbergs, are still in operation. Similar continuous records are in existence in Japan. As regards the British Isles, Cumberland was the scene of a busy copper enterprise conducted largely with Saxon and Bavarian labour, and several smelters were in operation at Keswick. Parenthetically, we may remark that the naming of the town in Shasta county, California, where the smelter of the Mountain Copper Company was erected, was unconsciously appropriate, the name, however, being taken from the patronymic of one of the directors, who was also one of the largest shareholders. But the Cumberland industry has been dead and forgotten for many a century. The mine on Pary's mountain in Anglesey, North Wales, was a large producer in the latter half of the eighteenth century, and for a dozen years the output was so great as to depress the price of the metal. At about the same time deposits were develop-

ed in Staffordshire and Cheshire, and the smelting industry in South Lancashire was founded to treat the ore produced there and in Wales. Systematic prospecting commenced in Cornwall about 1700, and ticketings were inaugurated in 1725. The rise of Cornwall as a copper producer from 1800 to 1855 was in its way as notable an event as that of the United States from 1865 onward. Though the actual figures appear small in comparison, the industrial influence was incomparably greater. In the year 1855, the output of Cornwall and Devon was 12,500 tons, selling for £100 per ton. After that year the productiveness of the mines began to diminish rapidly, and since 1885 their output has been a negligible quantity. With regard to the distribution of copper ores in the West Country during the heyday of its prosperity, we may record that the two most flourishing districts were around Gwennap and Camborne, where the Tresavean, Carn Brea, Dolcoath, Seton, and Basset were important producers. Other notable Cornish mines were near Land's End, St. Austell, Tywardreath, and Caradon, while the Great Devon Consols swelled the yield from the adjoining county. Though half-a-dozen mines continue to report an output of copper, the Levant is the only one that sells any substantial amount of ore, and even this is on the point of suspending operations. The only other part of the British Isles that has produced large amounts of copper ore is the south-east of Ireland. This industry is now in the same moribund condition as that of Cornwall, in spite of the efforts made by our friend Mr. Philip Argall to interest capitalists in the extensive deposits of low-grade ore in Wicklow.

The ore produced in England was invariably smelted in South Wales, Cornwall, or Lancashire. Smelting commenced at Swansea as far back as 1720, and shortly afterward in Cornwall. Eventually its close proximity to the anthracite mines gave the Swansea dis-

trict the advantage over Cornwall, and in 1815 John Henry Vivian migrated thither. All the copper produced was consumed in this country in the production of tubes and sheets: none was exported as metal, but the manufactured articles were sold abroad, particularly to America. Even in the most prosperous days of the Cornish mines the home demand was not met, and from 1820 onward, the supply was supplemented by shipments of ore and matte from Chile, with smaller amounts from Cuba. Until the year 1880 the supplies from Chile, and the adjacent regions, Bolivia and Peru, dominated the copper market of the world. South Australia entered the list of producers in 1844, and New South Wales in 1860, the ore being shipped to Swansea for treatment. The first shipments from Cape Colony arrived in 1853, but this ore was not sold at the Swansea ticketings, the Cape Copper Company erecting an independent smelting works at Britonferry. The United States began to produce in 1845, but the date of the commencement of great operations was 1867, when the Calumet & Hecla put its copper on the market. Montana and Arizona came forward about 1880, and Utah in 1905, while the increases from the disseminated copper of Nevada, Arizona, and New Mexico are of more recent date. It was only in the earliest days that any copper ore was sent from the United States to Swansea for treatment, for the shrewd men of America soon saw through the hollow pretence of competition among smelters at the Swansea ticketings. They set themselves to re-invent copper metallurgy. England, on the other hand, has been an excellent customer for American metal. The remaining countries to be considered, supplying copper and copper ore to England, are Spain and Portugal. In Roman times the Iberian peninsula yielded copper, and continued to do so throughout the Middle Ages. The mines, however, did not begin to assume an importance in the world's market

until about 1860. Twenty years before that date the English alkali-makers had decided to use the sulphur content of pyrite for the manufacture of sulphuric acid in place of Sicilian sulphur, which had been cornered by the King of Sicily, and they proceeded to use Cornish and Irish pyrite to meet their requirements. On the exhaustion of these supplies, they turned their attention to the Spanish and Portuguese deposits. The San Domingos and Tharsis were re opened with this object in 1860, by English companies, and at about the same time work was started at the Rio Tinto by the Spanish Government, which however sold the property to English investors in 1876. At these mines copper is extracted on the spot by washing and by smelting, but the bulk of the copper is exported in the pyrite, to be extracted by the Henderson process from the cinder, which after the removal of the copper is sold to the iron smelters.

The other countries contributing to the general supply of copper are Mexico, Russia, Norway and Sweden, Austria, Servia, Turkey, Canada, and Japan. The French were the first to develop Mexican deposits on a large scale and the Boleo company, in Baja California, has been profitable for many years. More recently the opening of Mexican copper mines has been in the hands of the Americans, as has also been the exploitation of the great low-grade properties of South America. Russia has been a constant producer for centuries from the oxidized ores of the Ural mountains, but the beneficiation of the sulphide ores lagged behind, until Anglo-American groups turned their attention to the subject during the last few years, with highly gratifying results. Norway and Sweden, Austria, Servia, and Turkey have been producers for many years on a comparatively small scale, and the details of the output need not be given here. As regards the Canadian production, most of it comes from British Columbia and is under the control of United States financiers. In any

case the copper goes to the United States for refining, and is marketed there. Japan has been a producer of copper from the earliest times. During the years 1870 to 1890 the ancient methods of extraction were gradually discarded and modern systems inaugurated under the direction of Professor William Gowland, who resided in that country as advisor to the Government for over fifteen years. Of the countries involved in the war, Belgium and France have never been producers of copper. France is naturally a large consumer of copper, and the shares of copper companies have always been attractive to French investors. Belgium also uses copper, and of late years much capital has been subscribed for the development of the Katanga deposits.

As regards the general output of copper, the world's production during 1912 and 1913 was, in round numbers, 1,000,000 tons. Of this total 550,000 tons, or rather over half, was produced in the United States. Much misapprehension has been caused in many quarters by the misinterpretation of the figures given by the American Copper Producers' Association relating to the deliveries of refined metal. For 1912 the deliveries were 699,000 tons, and for 1913 730,000 tons, so that the production of copper in the United States might be assumed to be 70% of the world's production. It has to be remembered, however, that all the Mexican and Canadian copper is sent to the United States to be refined, and is also much of the copper and matte produced in South America from the Cerro de Pasco, Braden, and other big mines. Until a year or so ago, Australian copper from Mount Morgan and Mount Lyell used to be sent to the United States with the same object. During 1913 the production in Canada was 34,000 tons, Mexico 50,000 tons, Cuba 3200 tons, Chile 40,000 tons, and Peru 25,000 tons. Russia produced 33,000 tons, and Japan 72,000 tons, Africa 22,500 tons, and Australia

46,000 tons, while the figures for Spain were 54,000 tons. As regards the consumption of copper we have already recorded the United States figures at 340,000 tons and those for Germany at 250,000 tons. England used 140,000 tons, France 100,000 tons, Belgium 15,000 tons, Austria 39,000 tons, Russia 40,000 tons, and Italy 31,000 tons. The only other large user is Japan, which consumes the greater proportion of the product of her own mines. As to the effect of the war, while consumption for peaceful purposes is checked, the wastage of copper in warlike operations is on a big scale, both on sea and land, so that the restoration of peace should bring a vigorous demand for the metal.

The Profession of Director.

The annual meeting of the Camp Bird company this year offered a striking contrast to that of twelve months ago. Then Mr. Arthur M. Grenfell not only presided, but dominated the assembled shareholders. It was a time of peace, which seemed unlikely to be broken. The only reference to disorder was a mention of Mexican affairs. This year Mr. Herbert C. Hoover was in the chair and in control of the administration. War on a most tremendous scale was being waged within 150 miles of the City. The former chairman was a bankrupt about to retrieve his honour on the battlefield, where his brother, Riversdale N. Grenfell, also a former director of the company, had already made the last sacrifice of a brave man for his country, while a third brother, Capt. F. O. Grenfell, had upheld the honourable traditions of the family by service so distinguished as to merit special mention by the general commanding the British forces in France. The mixture of tawdry finance and gallant conduct would puzzle a Lambroso were we not aware that gambling has undone many a man fit for noble service. Another contrast is afforded between the present chairman and his predecessor. The latter was one

of those well born speculators to whom promoting is made easy by a large and powerful acquaintance. His knowledge of mining was obtained at the expense of the shareholders whose properties he and his coterie administered. To him a mine was the counter for a clever speculation, financial manipulation, and, on occasion, a gamble. The shareholder, to him, was a necessary evil, one of the pawns in a game made for clever people like himself. The small shareholder, more particularly, was a mere nuisance, to be palavered or hectored, as occasion arose. His successor is of a type radically different. Mr. Hoover is an engineer who has made his own way all his life by sheer force of ability and persistence. Without engaging social aid or adopting the suave manner of the typical City man, he has brought to bear upon the business of mining a set of qualities that no director can possess without having served an apprenticeship to an exacting profession. His technical training in California has been supplemented by broad experience in mining regions and wide knowledge of mining affairs in many parts of the world. He brings all the directness of the American together with a financial acumen that is neither American nor European but wholly individual. We say frankly that the change in the chairmanship of the Camp Bird is an event of good omen, since it involves a recognition of sundry basic facts: for example, that the school of mines is entitled to precedence over the casino; that while mining is necessarily speculative, it is unnecessarily a gamble; that the primary purpose of mining is to extract metal from the ground and not from the pockets of a trusting public. Moreover, the Grenfell episode, in so far as it affects the affairs of three important mining companies, suggests, not for the first time, the great danger of delegating too much authority to one man, whether chairman, managing director, or secretary, while masking responsibility by means of

a number of complacent associates. Whether a director owns a big block of shares or whether he represents a large group of shareholders, he is still on the board as a trustee for *all* the shareholders. As a director, no member of the board should acquiesce in any step that is not for the benefit of the proprietary as a whole, not merely to the advantage of a particular group or firm. It was the sense of trusteeship that was lacking in the late chairman's conduct; his personal speculations were his immediate concern and when they went wrong he forgot his obligations to the shareholders that trusted him and so sacrificed their interests in an effort to extricate himself from a position that seemed difficult and that proved fatal to his solvency. Once more we repeat that the owners of a mine are the shareholders, *all* of them; the directors are trustees, for *all* the shareholders; the responsibility for administering the affairs of the mine rests upon the directors, *all* of them. While it is necessary that the chairman should be a man of dominating personality and executive ability, it is essential that his colleagues should be men of character, willing to co-operate, of course, but entirely unwilling either to approve of transactions that they do not understand or vote for motions of which they do not really approve. Dummy directors, coterie for boards, jobbers for chairmen, and other palpable defects in joint-stock organization will be corrected when we learn to regard directors as professional men. No code of conduct can be exacted so long as the ownership of shares is made the first requisite for a seat on the board. Ability and trustworthiness, and the reputation for both, are a better guarantee for devotion and sagacity than the purchase of 100 shares. Speaking for the public at large, we realize that we cannot expect from directors generally the observance of professional conduct until we give the occupation of directors the dignity of a profession.



SPECIAL · CORRESPONDENCE

MADRID.

How the war affects industries of all kinds in neutral countries is instanced by the parlous condition of the mining industry in Spain today.

Iron Ore.—The flourishing district around Bilbao depends for its prosperity on the export of hematite iron ore, the greater part of which goes to England, smaller quantities to Germany and America. The tonnage exported annually exceeds 4,000,000 tons and the industry employs, directly or indirectly, more than 50,000 persons. With the outbreak of war the whole of this activity was for a time suspended, and although shipments to England have been recently resumed the quantity exported during the month of September was barely 40% of the normal tonnage. The other important iron districts of Spain are in the provinces of Almeria and Teruel, which together turn out something like one half of the production of the Bilbao district, or say, two million tons. The mines of Teruel are understood to be completely stopped, and those of the Almeria district are working at less than a quarter of their normal output.

Lead.—The most important lead districts of Spain are in the provinces of Jaen, Murcia, Almeria, Cordoba, and Ciudad Real. Most of the ore is smelted in the country at the important establishments of Penarroja, Cartagena, Linares, and Puertollano, the lead being shipped for refining principally to Belgium, a part however going to England. At the outbreak of the war the smelting establishments were obliged to close-down, not only on account of the uncertainties of the market, of shipping facilities, and of the difficulties of transferring funds from one country to another, but because being in the hands of foreign companies, and their superior employees being foreigners, in nearly every case the commercial and technical heads of the business had to leave at short notice to take up their military duties, and in their absence the business could not be carried on. In the case of the Penarroja Company, for instance,

which owns both the largest colliery business and the largest lead-smelting business in Spain, no less than 150 employees, heads of departments, engineers, chemists, commercial and technical assistants of all kinds, left suddenly for France when war broke out, and the greater part of the business had to stop except as regards the output of coal for railway and other local consumption, throwing out of work directly and indirectly many thousands of work-people.

Pyrite and Copper.—The province of Huelva, as is well known, produces annually nearly 4,000,000 tons of pyrite, most of it for export, the principal value of which is represented by its sulphur contents, although the greater part contains also copper in quantity sufficient to materially enhance its value. Of the total export, about one million tons goes to America, more than half a million each to England and Holland (part of the latter for trans-shipment up the Rhine into Germany), and about a million tons is divided between Germany, France, and Belgium, more than half a million being for the first mentioned country. In consequence of the war, shipments to France, Belgium, Germany, and Holland have been suspended altogether, those to America have fallen off to less than one half of the normal amount, and even the small shipments to neutral countries have diminished. As a result, the mines of the province as a whole, not having any outlet for their product, have had to cease operations. San Miguel, Pena del Hierro, San Platon, La Joya, San Telmo, Castillo de las Guardas, and several smaller mines are shut-down completely. Rio Tinto is working half-time or less in most departments, the smelting plant and the South Lode mine being shut-down completely. Esperanza, the French Société de Pyrites and the United Alkali Company's mines are working something less than half-time. The only two companies that are still working full-time are the Tharsis and the Huelva Copper. The former, as is well known, is an important manufacturing concern

as well as a mining business, having works of its own in England, thanks to which fact shipments have been kept up almost normally and the working force has been maintained. In the case of the Huelva Copper, the ordinary channels through which its products were disposed were all choked by the war, and the only alternative to a shut-down was the finding of new outlets at a moment's notice. Fortunately the company has now a smelting plant in full operation, turning out blister copper of a degree of purity unusual for converter bars, namely 99 to 99.3%, and a shut-down was averted by the sale of small lots of an accumulated stock of this copper to local consumers in Spain and Italy, brass-founders, sheet-rollers, and the like, who were temporarily cut-off from their usual sources of supply.

MEXICO.

Since the Constitutionalists entered Mexico City they have not given any protection to Mexican property. This is especially so with respect to houses (furnished or unfurnished) and automobiles. Not only did they occupy a large number of the largest and most richly furnished Mexican houses, but they have proceeded to sell or carry away the furniture and personal effects of the owners. Our friend Bullock had to furnish them with two full-blooded horses of which he was very proud. In Toluca (representative of smaller towns) the State bank had to contribute 35,000 pesos, so the manager (who is a German) told me. The small merchants and stores there have had to contribute 5000 to 10,000 pesos each. I saw several receipts for such amounts held by Spaniards, and one by a Frenchman. Of course, this is all killing business. Merchants will not order stock, and, therefore, have run out of many lines.

So far, the mines have not been molested, as they are mainly owned by American and British concerns. There is, however, no cyanide to be had, as the supply for this country formerly came from Germany. The Dos Estrellas and one or two smaller mines alone have a good supply. The refinery in Mexico City has been closed-down, and now we have to ship out unrefined (doré) bullion. This is almost impossible, as the departments are all disorganized, and it is hard enough under normal conditions to follow out all the red tape regulations connected with taxes, &c. The taxes on silver are now double what they were before, and there is a danger that these ignorant people will further increase the taxation in spite of such a policy being harmful to the

country. I have tried to anticipate the future. The present Government is certainly of the people. That is why it is an ignorant looting crowd. For the same reason, however, it will have the respect of the mass of the Mexican people, and no new revolution can make much headway against it. The haciendas will be partitioned and much injustice done. The mines, however, which are the main foreign interests, will remain unhurt, except in so far as some temporary taxation is concerned.

CHIHUAHUA, MEXICO.

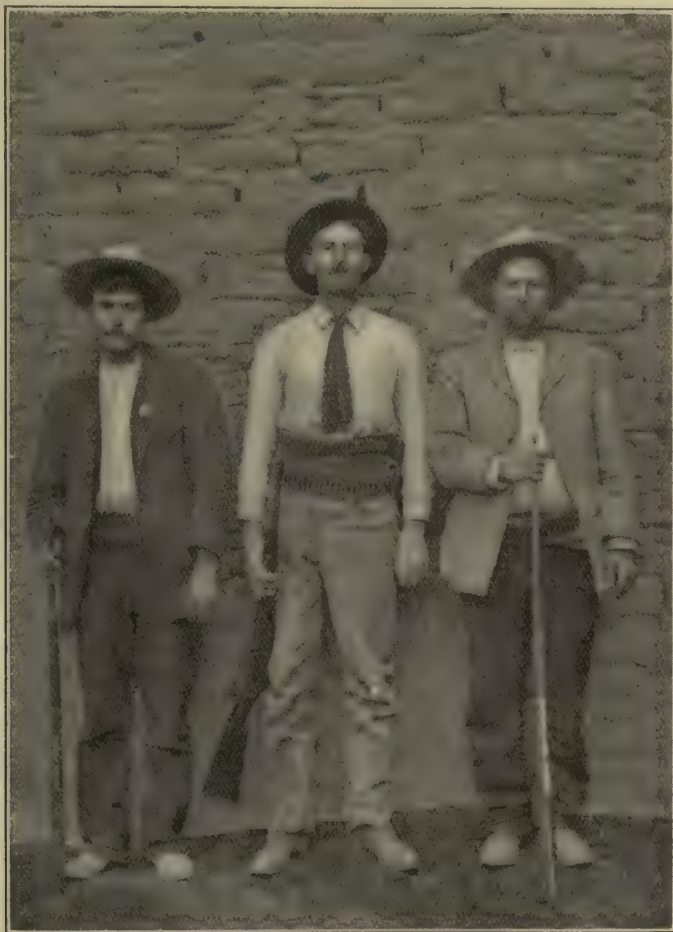
Mexico is far from settled, and the outlook is none too hopeful. Mail service is wretched and train service is irregular. Santa Eulalia is a mere shadow of its former self. The San Toy is doing a little work; the Potosi and Santa Domingo also are working, but much below capacity. The Buena Tierra is doing a little, while the Mina Vieja and Velardeña of the American Smelting & Refining company are also working on an extremely limited scale. All the other mines of the district are closed entirely. The Cristo, I understand, has been confiscated by the Constitutionalists, and a little leasing is under way. The Cusi Mining Co., operating the old Promontorio property at Cusihiuriachic, is working in a limited fashion, as the smelter will only take a small amount of the ore. All the Chihuahua ore is smelted at the A.S. & R. plant, there being no mills in the district. Labour shortage and uncertainty are the cause of general depression in the district. As to the future, everyone says "*Quien sabe*" and no one will venture a guess.

When I arrived at Chihuahua (on the first train after ten days suspension of traffic) most of the garrison had moved south because of the pending Villa-Carranza *disgusto*. The town is quiet and orderly, Villa is preserving order if nothing else, and is incidentally controlling all the public and a large proportion of the private utilities. Among other things, he has confiscated and is operating all the railroads, street-car lines, foundry, soap-factory, candle-factory, principal hotels, banks, is leasing parts of the large estates confiscated, renting all kinds of confiscated property; in fact, there are few things worth while in the State of which Villa and his crowd are not in possession. The mansions of the old *científico* crowd are occupied by Villa and his henchmen. The owners have been either summarily dealt with or are exiled at El Paso and other retreats along the border.

From Chihuahua I went to Jimenez, where

I had to wait two days for a train to Parral. I arrived there shortly after the execution of Sandoval (private secretary to Felix Diaz) and another sent by Diaz to make an alliance with Villa against Carranza. This may seem atrocious, but it is Villa's way of replying to the old *cientifico* party and the former enemy of Francisco Madero. Sandoval was a man

be another trouble-maker of the Zapata type, but has a large following. Before leaving for the hills, he declared himself against Villa and also against the *Americanos* that still had a foothold on "the sacred soil of Mexico" at Vera Cruz. He tried every means possible to get recruits, but I understand that he has suffered from many desertions. Chao's brigade



PASCUAL OROZCO AND TWO OF HIS OFFICERS. TYPES OF MEXICAN REVOLUTIONARY LEADERS

highly respected in Mexico City as one of its most prominent attorneys, and a man who saw him off at Juarez told me that his friends warned him that he would be executed; but he said that he had received letters from Villa and had no fear. Two days later he was executed and buried in a little old churchyard on the outskirts of Jimenez.

I reached Parral shortly after Moclovio Herrera and his brigade of so-called revolutionists evacuated the town. He appears to

was at Parral when I arrived, and I don't think anyone will see a more motley assemblage of 'soldiers,' from old *peones* in red *serapes* and straw sandals, to 12 or 14 year old boys in overalls, scarcely able to shoulder the old Kragg Mauser, shot-gun, or whatever implement of warfare they happened to have. The 'officers' (and there is a superabundance of them with every revolutionary brigade) are smartly clad in khaki, Stetson *sombrero*, polished puttees, with a fancy sword and Colt

automatic much in evidence. To the disinterested onlooker, Parral with its garrison presents a picture of mingled pathos and comedy. Mining in the district is exceedingly quiet. The Alvarado is doing some work, and the hacienda Pamilla is the only mill doing anything. At Santa Barbara, the El Rayo (of the Mines Company of America) is operating, and the Tecolotes property of the A.S. & R. Co. is doing a little work. At the Almoloya also a little work is being done. Otherwise the district, which is one of Mexico's greatest silver producers, lies idle, biding the time when there will be some assurance of a lasting peace. There is practically no mining being conducted near Torreon and farther south in the Zacatecas district, and no train service to Mexico City. Before leaving Jimenez I was talking with a *cargador* at the station, and it occurred to me that he summed the situation pretty well in two words, when he said "*nosotros ganen*" (we win). It is a class struggle in Mexico, the *peon* and *pelado* against the graft element; at present the under dog is having his day. As for the future, *quien sabe*?

TORONTO.

Porcupine.—The output of this district is steadily increasing, as a result of extensive additions and improvements to the plant of the leading mines, and it is anticipated that the total production of gold this year will be over \$5,000,000. The Dome has shown a most decided improvement as regards tonnage treated; this in September amounted to 21,940 tons, as compared with 16,180 tons in May. The value of the September output was \$99,301. The average value per ton milled was \$4'52, but a decrease in the grade will shortly be experienced, there being available an enormous proportion of ore carrying about \$3'50 per ton; of this material there is estimated about 3,000,000 tons. This can only be treated profitably by reason of the reduction in the mining and milling cost recently effected, cutting this outlay down to about \$2'50 per ton, which should insure substantial profits and put the company on a dividend-paying basis before long. The 4-weekly statements of the Hollinger continue satisfactory. The last issued, covering the period ending September 9, showed a surplus on hand of \$1,043,957. The gross profit for the four weeks was \$152,821 from the treatment of 19,828 tons of ore averaging \$12'40 per ton, the approximate extraction being 93% and the working cost \$3'86, being a decrease of 30 c. per ton. The com-

pany is amply provided against a shortage in chemicals and other foreign-made supplies, having good stocks on hand. Three new compressors, each having a capacity of 4500 cubic feet, are being installed, and as soon as they are in good working order the force of men will be increased to 1200. Negotiations for the purchase of a controlling interest in the McIntyre mine by the Nipissing, of Cobalt, have fallen through. The mill of the McIntyre has been enlarged to a daily crushing capacity of 300 tons, and underground development is meeting with good results. The contact vein, which was faulted on the 500-ft. level, has been picked up and is being worked; efforts are also being made to reach this orebody on the 600-ft. level. An arrangement has been made with the Schumacher to test the McIntyre territory lying below Pearl lake from one of its shafts. The ore assured will suffice to run the mill for 15 months. The new Hardinge tube-mill of the Vipond is in successful operation with sufficient ore proved above the 300-ft. level to keep it running for 20 months. The first representative clean-up after the necessary readjustments had been made realized about \$11,000. A vein system entering from the North Thompson property adjoining has been opened up in the north-western part of the property. At the Dome Lake the new mill, with a crushing capacity of about 100 tons per day, has been started, though some changes will be required before it is in regular working order. The main shaft is down to the 400-ft. level. On the 300-ft. level there are three separate ore-shoots. No. 3 vein has been opened up for 100 ft. and shows rich ore with the mineralization evenly distributed.

At the Tough-Oakes in the Kirkland Lake district, underground operations have been suspended until the new 100-ton cyanide mill is ready. Production is continued meanwhile with a small 5-stamp mill with a capacity of 12 tons daily, and there is more ore on the dump than can be treated for many months. The output so far this year amounts to about \$100,000.

Cobalt.—Bullion shipments for 1914 from this camp to date amount to a total of 6,385,247 oz., valued at \$3,553,192. The supply of cyanide, which, it was feared, would run short, is now assured, so that the danger of a general closing-down for this cause is now past. More ore is going to the Canadian smelters at Thorold and Deloro, both of which continued to receive ore for treatment during the early days of the war, when it was not accepted by the American smelters. During

September the Nipissing mined ore valued at \$202,243, and shipped bullion estimated at \$351,424. Stopping three branch veins on the second level from shaft No. 73 produced considerable ore during the month, one of the veins showing 3000-oz. mineral over a width of 2 to 3 in., besides low-grade ore. Driving on No. 64 vein from the 900-ft. level produced no important results. The La Rose is carrying out the policy, recently adopted, of thoroughly prospecting the unexplored portions of its territory. About 50 men have been set to work stripping the overburden of

on October 1, but milling will not be undertaken until there is a considerable tonnage of ore on hand. The main shaft is down 768 ft. with a station at 750 ft., where a vein of high-grade ore several inches wide has been cut. The Beaver has also resumed underground work. A good strike has been made at the Savage, a rich but short ore-shoot having been found at the 110-ft. level, on which a winze is being put down.

Sudbury.—The war has seriously affected the operations of the Canadian Copper Co., a subsidiary of the International Nickel Co.,



THE TRAIL SMELTER OF THE CONSOLIDATED MINING & SMELTING CO. OF CANADA.
A WINTER SCENE IN BRITISH COLUMBIA.

the high bluff north of the present workings of the main property. A deep exploratory shaft is being sunk on the La Rose Extension to reach the conglomerate formation, which is about 400 ft. below the surface. A cross-cut is being run from the 180-ft. level of the Lawson to the old shaft of the University to open up intervening territory. The annual report of the Kerr Lake for the year ending August 31 shows a profit of \$620,786, as compared with \$769,176 in the preceding year. The silver output was 1,829,424 oz., as against 1,855,495 oz., and the average cost of production has increased from 18'30 cents per oz. to 24'86 c. The estimated ore reserve is 5,698,000 oz. The Timiskaming, which closed-down in August, resumed mining operations

most of the output of which went to Germany for the manufacture of armour plate. Four of the six furnaces of the company at Copper Cliff were closed, though two of these have since been started again. Only one of their mines, the Creighton, is being worked. The Mond Nickel company, the ore of which goes to the British market, is busy, five mines being in operation, and is also buying nickel ore for its new smelter at Coniston from the Alexo mine near Porcupine. Since the war the prohibition of the exportation of nickel to foreign countries has been strongly advocated, and the question will probably come up in Parliament. [This has been done, since our correspondent wrote, by a proclamation issued on October 29.—EDITOR.]

CAMBORNE.

The war has not had the adverse effect on Cornish mining that was anticipated in some quarters. In the early weeks of the conflict, the closing of the metal market, and the consequent absence of prices, created a difficulty, for the mines were unable to sell their products. This was overcome to some extent by temporary advances on the security of the tin concentrate from the banks and certain public-spirited men, an arrangement which enabled the mines to continue on a reduced scale. The re-commencement of the ticketings on September 21 facilitated a resumption of normal working conditions. The average price realized for black tin at the ticketings of September 21, October 5, October 19 and November 2 has been low, namely, £72. 5s. 0d., though it is only £10 per ton lower than the average price secured at the last ticketing before war began. Such a fall was not unexpected, war or no war, for the supply of tin had for some months exceeded the demand. Prices for materials have not seriously advanced, except in one or two instances, such as explosives. The larger mines are covered at the old prices until the end of the year, and some for a longer period. To off-set the lower price for tin and any advance in the price of materials, there is the fact that the managers have in most cases been able to reduce wages by re-arranging the prices paid on contract. The high price of tin and the shortage of miners caused wages to rise to a level which obviously could not be maintained during periods of depression, and now that labour is fairly plentiful, the managers have not been slow to reduce prices to an extent necessary to meet the altered conditions. The miners will now have to put more vim into their work if they are to earn the same money as formerly. There is no reason why, if they put in full time and work harder, their pay should be much less. Recruiting in Cornwall among the miners for the Army has not been specially brisk, for little real distress is felt, and life is much as in normal times. Recruiting meetings have been held in most of the towns and villages, but the speakers have invariably been unequal to the task of arousing enthusiasm, even when aided by patriotic songs and recitations by members of the fair sex. In the clay district, some of the companies are now discharging all unmarried employees of enlistment age with the object of forcing these men into the ranks.

The war and the continued depression in the tin market have made it impossible to raise money for those mines which were in

financial difficulties. Condurrow (for which the late Peter Watson and his friends found the working capital) has had to stop, and operations at Phœnix in the Liskeard district have also been terminated. All work has been suspended at Killifreth, North Dolcoath, Prince of Wales, and Wheal Hampton.

Levant.—The statement of account issued by the Levant mine for the sixteen weeks ended September 26 showed a loss of £354, in spite of the fact that the return of black tin had been raised by 33 tons over the figure for the previous sixteen weeks, and the labour cost had been reduced by £1861. The loss was occasioned by a fall in the average price of the tin produced of £11. 7s. 6d. per ton. Nothing was said at the shareholders' meeting about the renewal of the lease, which expires within a few months, the chairman merely stating that "they had decided to work on for the sake of the miners of the district generally, provided it could be done without very considerable loss." To enable this to be done, all underground contracts have been reduced 20% and the wages of all other employees by 15%. This seems to be the only direction in which costs can be cut, and although the course will not be palatable to the men, it is a step taken in the interests of the 2000 persons dependent on the mine.

Goss and Tregoss.—The company working the alluvial tin of the Goss and Tregoss Moors, near Roche, has gone into liquidation, but it is understood that Mr. C. G. Lush, who is the principal debenture holder, intends to continue to work the property, being convinced that it can be made to earn a profit even at present prices. He proposes, when conditions are better, to form another company with a small nominal capital to take over the property, and as the dredge now appears to be again in the best tin ground, the prospects seem fairly good provided prices improve.

Good discoveries are reported from the property worked by the South Mount Boppy company, and also from Wheal Kitty and Penhalls. The former is situated near Liskeard, and is under option to the company named. It is traversed by several lodes, which are being vigorously prospected, and a rich strike is now reported to have been made at Pope's shaft. At Wheal Kitty and Penhalls a fine bunch of tin has been encountered in the 730-ft. level west from Sara's shaft. Owing to the lode being cut off by a slide, backs of only about 12 fathoms in height are available, but as the ground is rich, a little of it helps to sweeten the ore from other sections. The work

of preparing the foundations for the new mill at Wheal Kitty is well forward. The battery will consist of 24 Californian stamps.

NEW YORK.

The War in Europe continues to have a hampering effect on the mining industry of the United States. This is, of course, most marked in the copper industry. Many of the smaller mines have stopped work entirely and the larger ones are only working at half-capacity. Meanwhile the price of copper has steadily declined until it has reached a figure at which few of the larger companies can make any money when working on a reduced scale. England, France, and Italy are the only countries to which shipments can be made with ease and safety, since the English government has been hindering shipments to Holland and to Scandinavian countries on the ground that metal consigned to these countries is likely eventually to find its way into Germany. Some shipments consigned to Holland were seized by the British government and the shippers were paid for the copper. This, of course, was disliked by the shippers here because the British government did not pay as high a price as they expected to realize in Holland, and the copper thus diverted to England merely served to reduce the English consumption with metal on which a higher freight and insurance rate had been paid. As a result of all this, the shipping companies operating between Holland and Scandinavian countries and the United States are objecting to carrying copper and the insurance rates have advanced considerably. The British government has also been diverting shipments of oil consigned to these countries, and the whole matter is tending to create an unfavourable sentiment toward England in the United States. The action of England in inviting Japan into the war had already caused not a little feeling here, and recent cases in which American ships have been seized by British cruisers have increased this irritation. The American public quite naturally feels that if the British government thinks that Holland and the Scandinavian countries are furnishing material to Germany, the proper course for it to pursue is to force those countries to cease such trade. Interference with American shipping is a subject on which the American public has been exceedingly touchy for the last hundred years or more, and from the standpoint of diplomacy alone it would seem that it would be well for the British government to modify its policy in this matter.

Cyanide.—This matter of ocean transport is important to our gold-producers, since the diverting of an American ship to a British port may operate to cause a serious shortage of cyanide. Until the war broke out the American supply of cyanide came largely from Germany. Roessler & Hasslacher, the chief importers, foreseeing the possibility of trouble, had ordered an extra supply of cyanide, but war was declared before it could be shipped from Amsterdam. Various interests dependent on material supplied by Germany held a conference at Washington last month, in which Secretary Bryan of the Department of State and Secretary Redfield of the Department of Commerce participated, and arrangements were made for cyanide, dye-stuffs, sugar-beet seed, and various other goods ordinarily imported from Germany to the United States in American ships. The cyanide importers secured cargo space in the tank steamship *Sun* owned by a Philadelphia oil company, which was to take oil to Amsterdam and return to Rotterdam, where she would load with the cyanide. At the time that the ship was expected in Antwerp it was reported that she had been taken into Falmouth. No word has since come as to whether she has been released and allowed to proceed or not. If it is impossible to get the cyanide delivered in America a serious shortage will result, for the one plant in America is barely able to supply the cyanide used in the United States alone and is unable to contribute anything toward the demands of Mexico, where the consumption normally is more than twice as great as in the United States. Some operators who had only small stocks of cyanide on hand are already feeling the pinch. If the material is withheld much longer some of the plants will have to cease work. Now that gold is so much in demand it would be exceedingly awkward if the output should be decreased because of the lack of a small quantity of cyanide.

[The American view, as expressed by our correspondent, is interesting, but open to objection from us. Japan was not "invited into the war." She fulfilled her duty according to treaty. The delay or diversion of sundry shipments of copper or cyanide may annoy some of our friends on the other side, to whom business is more immediately important than a life and death struggle between great nations in Europe, but they must not be in a hurry to condemn a government that is defending a great cause, and, in doing so, fails to appreciate the maintenance of ordinary trade between the spectator countries.—EDITOR.]

PERSONAL.

WALTER BROADBRIDGE, who organized the drilling class in Salisbury House, has been appointed captain in the Royal Garrison Artillery.

W. L. BROWN is on his way to West Africa.

R. H. B. BUTLER, who was at Brussels when the Germans arrived, has returned to London.

GELASIO CAETANI passed through London on his way to Rome.

P. J. A. CLAUDET participated in the defence of Antwerp, as a lieutenant in the Royal Naval Volunteer Division. He returned unhurt. His elder brother, F. H. B. Claudet and his younger brother, Richard O. Claudet, are both in the second battalion of the Honourable Artillery Company. Another brother, G. F. Claudet, is at Woolwich. Thus Arthur Claudet's name is being honoured by all of his four sons.

J. H. CURLE has joined the Sportsman's battalion of the Royal Fusiliers.

J. C. FARRANT is a prisoner of war at Doeberitz.

ROWLAND FEILDING has been promoted to major in the City of London Yeomanry.

R. M. GEPPERT has returned from Siberia, by way of Japan and America.

F. LYNWOOD GARRISON is in Santa Domingo.

HARRY G. HANN has returned from the Bodaibo district, Siberia.

SIR THOS. HOLLAND is Major Commandant of the Manchester University Officers Training Corps.

THEODORE J. HOOVER has returned from the United States.

J. R. HORSLEY is on his way from the Troitzk Goldfields to Canterbury.

R. H. JOHNSON, of Laws, Rumbold & Co., has returned from Naraguta, Nigeria.

H. I. KEEN is at Petrograd.

NORBERT KEENAN is here from Western Australia.

H. H. KNOX has returned from the Altai, by way of Finland and Norway.

A. E. KITSON, director of the Geological Survey of the Gold Coast, sailed on October 28 on his return to the colony.

F. P. LACEY has returned from Pachuca and has joined the Westmorland and Cumberland Yeomanry.

DAVID H. LADD has returned from the United States.

HENRY W. LAWS escaped from Antwerp, going to Ostend.

STEPHEN J. LETT returned from South Russia by way of Tornea, at the head of the Bothnian gulf, thence through Christiania and Bergen to Newcastle.

W. RANDOLPH VAN LIEW, manager for the Caucasus Copper Co., sailed for New York on October 17, after a sojourn in France.

W. S. MCCALLAM has gone from Penang to Georgetown, in British Guiana.

H. G. NICHOLS has returned from Burma. He has severed his connection with Bainbridge, Seymour and Company.

B. H. NICHOLSON was a member of the Naval Brigade that went to Antwerp. He returned safely.

FRANCIS NICHOLSON sailed for New York by the *Minnewaska* on November 7, on his way to El Paso.

W. H. MERRETT, assistant professor in the Royal School of Mines, is now captain in the Royal Engineers.

FRANCIS F. OATS is major commanding the No. 2. Heavy Battery, Cornwall, Royal Garrison Artillery.

LLEWELLYN PARKER is home from the Argentine.

W. PELLEW-HARVEY is due in London from Australia on November 27.

A. L. QUENEAU was at Dunkirk with the French heavy artillery early in October.

ALEXANDER RICHARDSON has joined the staff of the Royal School of Mines as demonstrator in mining.

H. P. ROBERTSON has obtained a commission in the Auxiliary Service Corps.

P. A. SATOW is at Batu Gajah, in the Federated Malay States.

R. E. SMITH has been appointed chief engineer for the Lena Goldfields.

H. T. STRETTON, of the La Blanca mine, Pachuca, has arrived from Mexico.

J. W. TEALE, of Bainbridge, Seymour & Co., has obtained a commission in the Naval Engineers.

H. W. TURNER has arrived from Omsk, by way of Finland and Norway.

C. A. VAUX has returned from the Malay States, and obtained a commission in the Royal Artillery.

D'ARCY WEATHERBE is expected in London on his return from Canada.

H. E. WEST has returned from the Kolar district, India, to Santa Barbara, California.

W. FISCHER WILKINSON holds a commission in the Transport Service.

THE ROLL OF HONOUR.

Additions and Corrections.

- ALLAN, A. C.
11th Middlesex.
- ASH, R. BERESFORD
Public School Corps.
- ALLEN, P. K.
10th West Yorkshire.
- ANDREWS, C. T.
Engineers, Royal Naval Division.
- BAKER, A. F. W.
3rd Duke of Cornwall's Light Infantry.
- BARNARD, G. C.
3rd Royal Warwickshire.
- BATTYE, PERCY
4th Grenadier Guards.
- BEADON, W. R. C.
Moulmein Volunteer Rifles, Burma.
- BEVAN, A. G. M.
Sportsman's Battalion, Royal Fusiliers.
- BLANE, J. P.
King's Royal Rifle Corps.
- BONDS, PERCY
1st Royal Devon Yeomanry.
- BRAY, FRANCIS P.
Sportsman's Battalion, Royal Fusiliers.
- BROADBRIDGE, WALTER
Royal Garrison Artillery.
- CANTOR, B. C. M.
South Rhodesia Volunteers.
- CARROLL, C. M.
Royal Field Artillery.
- CHAPLIN, G. P.
Royal Garrison Artillery.
- CHARLTON, B. H.
4th Yorkshire Regiment.
- CLARKE, A. CECIL
Duke of Cornwall's Light Infantry.
- CLAUDET, F. H. B.
2nd Honourable Artillery Company.
- CLAUDET, P. JOHN A.
Royal Naval Volunteers.
- CLAUDET, R. O.
2nd Honourable Artillery Company.
- CLEMENT, JULIAN
10th Hampshire.
- COLLINGS, G. S.
Intelligence Dept., Expeditionary Force.
- CORDNER-JAMES, PHILIP
9th Duke of Cornwall's Light Infantry.
- CURLE, J. H.
Sportman's Battalion, Royal Fusiliers.
- DANNATT, C. W.
Queen's Westminster Rifles.
- DAVIS, G. E.
Essex Yeomanry.
- DAY, HAROLD D.
2nd Royal Field Artillery.
- DE LA MARE, S. H.
Montgomeryshire Yeomanry.
- DENNISON, J. B.
3rd Wessex R.F.A.
- ELLIS, G. F.
Cavalry Division, Army Service Corps.
- ELLIS, R. W.
11th Royal Fusiliers.
- EWEN, DONALD
London Scottish.
- FITZPATRICK, A.
1st Royal Field Artillery.
- FRAYLING, B. E.
Royal Engineers.
- FRIEDLANDER, O. A.
New Zealand Expeditionary Force.
- FURNELL, R.
Scottish Horse.
- GILBERT, FREDERICK
Duke of Cornwall's Light Infantry.
- GOODWIN, F. C.
Royal Engineers.
- GRAY, E. L.
4th Royal Scots.
- HALL, T. C. F.
Royal Engineers.
- HANNAH, R. W.
Army Service Corps.
- HOCKING, J. RAYMOND
3rd (King's Own) Hussars.
- HOLLOWAY, W. S.
Sportsman's Battalion, Royal Fusiliers.
- HOLMES, FRANK
Royal Naval Brigade.
- HUTCHINSON, J.
Lovat Scouts.
- HUTT, E. R.
6th Royal Scots Fusiliers.
- HUTTON-WILLIAMS, W.
3rd East Surrey.
- INMAN, D. H.
Royal Engineers.
- JAMESON, C. F.
London Scottish.
- JENNINGS, R. C.
Army Service Corps.

- JOHNSON, H. H.
6th Royal Sussex.
- KENT, G. H. S.
Signal Troop, 3rd Cavalry Brigade.
- LACEY, F. P.
Westmorland & Cumberland Yeomanry.
- LANDALL-MILL, T.
1st Surrey Rifles.
- LANG, E. A.
Royal Naval Reserve.
- LEWIS, T. E.
5th South Wales Borderers.
- LIPPERT, R. E.
Royal Field Artillery.
- LITTLE, T. H.
Worcester.
- LYDEKKER, G. O.
5th Bedfordshire.
- MARSHALL, G. W. S.
Duke of Cornwall's Light Infantry.
- MCCLURE, G. B.
8th Black Watch.
- MCKINLEY, J. G.
Royal Flying Corps.
- MCNEILL, JAMES
3rd Glasgow Highland Light Infantry.
- MERRETT, WILLIAM H.
Royal Engineers.
- MERRY, PERCY B.
13th Royal Fusiliers.
- MILLS, S. C.
Duke of Cornwall's Light Infantry.
- MOORE, R. INGRAM
Australian Contingent.
- NEWBERRY, H. W.
2nd King's Royal Rifles.
- NEWBOLD, E.
4th P.S. Royal Fusiliers.
- NICHOLAS, W. L. J.
3rd The Buffs (East Kent).
- NICOLAUS, G. R.
Sportman's Battalion, Royal Fusiliers.
- OATS, FRANCIS F.
Royal Garrison Artillery.
- PARTRIDGE, R. W.
88th Victoria (B.C.) Fusiliers.
- PEER, C. S.
11th County of London.
- PENNEY, J. C.
13th Royal Scots.
- POOL, JAMES G.
4th Duke of Cornwall's Light Infantry.
- RAINE, P. E.
Duke of Cornwall's Light Infantry.
- RICHARDS, H. B.
Sportman's Battalion, Royal Fusiliers.
- RICKARD, J.
London Scottish.
- ROBERTSON, H. P.
Auxiliary Service Corps.
- RUNDALL, W. H.
Sportman's Battalion, Royal Fusiliers.
- SCHACHT, HENRY C.
City of London Yeomanry.
- SEARLE, D'ARCY
Royal Fusiliers.
- SIMON, R. O.
7th Royal West Kent.
- SMITH, F. S.
Public Schools, 12th Middlesex.
- SOLOMON, A. A.
13th Royal Fusiliers.
- STICKLAND, R. G.
5th Royal Field Artillery.
- STOCKINGS, GEORGE M.
Sportman's Battalion, Royal Fusiliers.
- STRICKLAND, A. F.
Royal Naval Division.
- TEALE, J. W.
Engineers, Royal Naval Division.
- TEED, P. LITHERLAND
Royal Naval Volunteer Reserve.
- TOMLINSON, D. W.
2nd King Edward's Horse.
- TONKIN, T. C.
Royal Engineers.
- ULRICH, G.
New Zealand Expeditionary Force.
- VARVILL, W. W.
4th Northumberland Fusiliers.
- VAUX, C. A.
Royal Artillery.
- VINCENT, HAROLD J.
West Kent Yeomanry.
- WATSON, J. C.
6th West Yorkshire.
- WEBB, R. C.
Sportman's Battalion, Royal Fusiliers.
- WELMAN, H. B.
Royal Marines.
- WHITEHEAD, P. C.
Royal Field Artillery.
- WHITTUCK, J. C. S.
10th Worcestershire.
- WILBRAHAM, A. G. B.
Honourable Artillery Company.
- WILD, R. P.
3rd University & Public Schools Corps.
- WILKINSON, W. F.
Embarkation Staff of Regular Army.
- WILLIS, J. K.
5th Duke of Cornwall's Light Infantry.
- WOLFF, M. A.
72nd Seaforth Highlanders.
- WOODFORDE, E. B.
Sherwood Foresters.

THE KENT COAL-FIELD

By E. B. LICHTENBERG

Geological.—The coal-measures of Kent are concealed by overlying Mesozoic rocks; their discovery therefore was the result of observation and inference by geologists during the last sixty years. The credit of expounding the basic theory upon which all further research was built is given by every subsequent investigator to R. A. C. Godwin-Austen, who, in 1855, read a paper before the Geological Society on 'The Possible Extension of the Coal Measures beneath the South Eastern part of England.' His idea was that the folds in newer rocks are formed along the same lines as those in the older rocks beneath them, and that the folds in Carboniferous and pre-Carboniferous strata, even when at great depth, are traceable by the folds in the newer sediments at the surface. He showed that the general direction of the exposed coal-fields in South Wales and Somersetshire on the west and of the Belgian and North French coal-fields on the east, was ruled by a series of tectonic folds running east and west parallel to the great line of disturbance centred in the ridge or axis of Artois from the south of Ireland, through South Wales, and northern Somerset into Westphalia. Throughout this area the exposed coal-fields lie in long, narrow, east-and-west troughs. These troughs were formed at the close of the Carboniferous age, the coal-bearing alluvia being thrown into a series of folds, the upper portions of which were denuded, so that most of the present coal-fields are synclines of the original curves. Great lines of disturbance and dislocation were developed at the end of the Carboniferous period, the destruction of the upper curves of the folded rocks being effected prior to the deposit of the newer Triassic, Liassic, Oolitic, and Cretaceous strata.

In the year 1893, M. Bertrand, applying the principles laid down by Godwin-Austen, in a paper before the Institution of Mining Engineers, pointed out that the folds in the Palæozoic floor in France are traceable even where they are covered by a great thickness of newer rocks, because a fault or fold when once established in an older rock, is, if there be any subsequent movement, marked also in the newer strata. The discussion on this paper led to the conclusion that while the great tectonic folds are thus traceable, this need not apply

to the minor anticlines and synclines in the super-imposed rocks. The folded coal-fields along this line are of the same mineral character, and the pre-Carboniferous rocks are the same in Somersetshire as on the Continent.

Sir Joseph Prestwich in his report to the Coal Commission of 1871 supported the Godwin-Austen theory. He said "We know that the great original coal-trough has been broken up into separate basins. The direction



TILMANSTONE COLLIERY.

of this trough is, we think, likely to be on a line passing through North Wilts and Oxfordshire, thence across Hertfordshire, South Essex, and the North Eastern extremity of Kent onward toward Calais, or in the case of the anticlinal axis taking a more southerly course, we should look for the coal-basin or basins along a line passing from Radstock through the Vale of Pewsey and thence along the North Downs to Folkestone." He concluded that coal-fields of the same kind and value as those of Somerset and of North France and Belgium do exist underneath the

newer rocks of southern England, and the very coal measures that disappeared in the West under the newer rocks of Somerset re-appear in the East from underneath the newer rocks of the Continent along the line of the ridge of the 'Axis of Artois.' As a practical result of these theories a bore-hole was put-down in 1872 at Netherfield about three miles south of Battle, to test the existence of the Carboniferous and pre-Carboniferous rocks in the Wealden Area, where the lowest rocks of the Wealden formation constitute the bottom of the valley. The bore-hole was abandoned in 1875, owing to the breakage of lining-pipes and to the loss of the boring-tool, at a depth of 1905 ft. in the Oxford Clay. Professor W. Boyd Dawkins, who selected the site, says, in his statement before the Royal Commission of Coal Supplies, 1903: "We may infer from the fact of the bottom of the bore-hole being in the Oxford Clay, and from the known thickness of the Bathonian Oolitic strata in the nearest places, that the Coal Measures lie buried beneath considerably more than 2,000 ft. of newer rocks." This bore-hole showed that the search would have to be carried out at some spot farther north. In the district of Battle the Oolitic rocks were proved to be more than 1700 ft. thick. The great and increasing thickness of the Wealden above them, forming the surface of the ground between Netherfield and the North Downs, rendered it desirable to go to a line along the North Downs, where Godwin-Austen believed that the Wealden beds abruptly terminated against the ridge of Coal Measures, where, therefore there would be a better chance of success. Further evidence was being collected in various sinkings for water through the London Clay, Chalk, and other terrains, that proved the existence of the ridge in question, consisting of Silurian strata and Old Red Sandstone. There proved to be no Wealden strata and the Oolites at their maximum were not more than 87 ft. thick. The rocks composing the ridge were inclined at a high angle, as in the case of similar rocks underlying the coal-fields of Somerset, Northern France, and Belgium; this implying the possible existence of troughs of coal in the synclinal folds of neighbouring areas. It was obvious therefore that the line of the North Downs was the desirable region for a second experiment.

In 1886 Boyd Dawkins reported to Sir Edward Watkin, chairman of the South Eastern Railway and Channel Tunnel company, that a boring should be made in the neighbourhood of Dover, and that the Channel Tunnel works

offered the best site for the trial. The work was begun in 1886 and was completed in 1891, having proved the existence of workable seams of coal. The boring began in the Lower Chalk at the foot of the Shakespeare cliff and was continued down through the following strata: Grey Chalk, Chalk Marl, Glauconitic Marl, Gault, Lower Greensand, Wealden Purbeck, Portlandian, Kimmeridgian, Corallian, Oxfordian, Bathonian, Liassic, ultimately striking the Coal Measures at a depth of 1100 ft. below Ordnance Datum, and was sunk further to 2270 ft. below C.D. or 2330 ft. from the surface, still in the Coal Measures. In 1897 the Kent Collieries company began to sink shafts at the foot of the Shakespeare cliff and to put-down bore-holes at Brabourne and at Pluckley, near Ashford, to the west of Brabourne. See the accompanying map. Borings were also put-down by various exploration companies at Penshurst, still farther west, near Tonbridge; at Ottinge; at Hothfield, near Ashford, and Plaxtol, north of Tonbridge; and at Ropersole, eight miles north of Dover. Only two of these bore-holes, Brabourne and Ropersole, were deep enough to enter the Palæozoic floor.

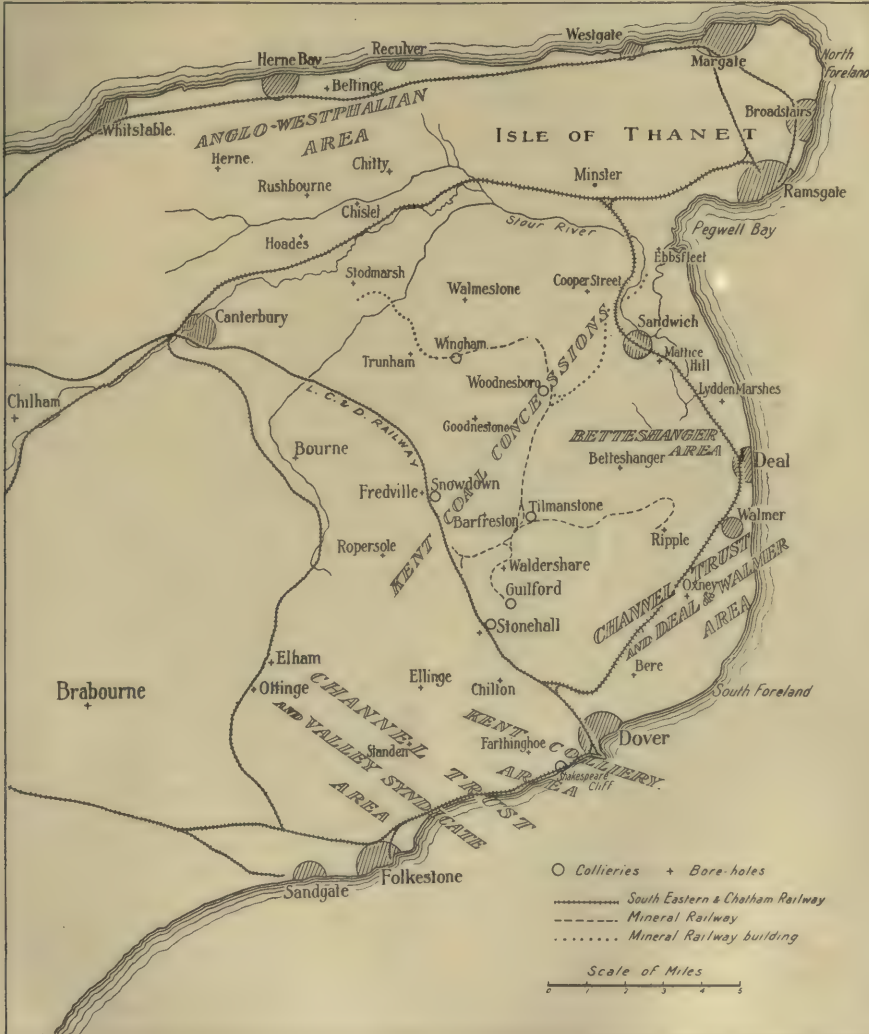
Beginning in 1904, the Kent Coal Concessions put-down several bore-holes as shown on the map and described in Malcolm Burr's paper 'Ten Deep Borings in East Kent.' From that date to the present numerous bore-holes have been put-down (as shown on the map) and the shafts of the Snowdown, Tilmanstone, and Shakespeare collieries have been sunk to workable coal seams.

The proved area of the coal-field is approximately 100 square miles, with the probability of an extension of 50 square miles. The boundaries of the basin have not yet been definitely ascertained. But the bore-holes at Brabourne and Chilham appear to define the western boundary. That at Brabourne was bored through the Cretaceous, Jurassic, and Triassic strata, which were proved to lie unconformably upon the Devonian, dipping at an angle of about 30° , and that at Chilham upon the Upper Silurian shale, so that allowing for the incoming of the Carboniferous limestones and millstone grits that underlie the Coal Measures, the western boundary must be considerably east of these bore-holes. The borings at Ropersole and Ellinge show the cover of the Secondary rocks over the Coal Measures to be thicker on the western boundary by nearly 500 ft. than farther east; moreover, the coal-seams are thin and split so that they are not likely to be worked profitably.

The western boundary may be taken to be practically the main road from Whitstable to Canterbury and from Canterbury to Dover as far as Ropersole, and then it might be correct to deflect the line from Ropersole to a point half-way between Dover and Folkestone.

Along the north side of the river Stour there

The mean thickness of coal appears to be about 20 to 25 ft. in the northern part of the field, gradually thickening to about 60 to 65 ft. southward. The disadvantage of the smaller thickness of workable coal is to some extent outweighed by the absence of the water-bearing Secondary rocks, namely, the Folke-



appears to be strong evidence of 'thinning out' of the Coal Measures, and the prospecting now being done by the Anglo-Westphalian Co. should eventually settle the question as to whether there is a further syncline to the north. The Coal Measures appear to stretch seaward from Ebbsfleet all round the coast to about half-way between Dover and Folkestone, so that this may be termed the approximate east and south boundary.

stone and Hastings beds, both of which thicken to southward.

Tilmanstone.—Shafts have been sunk to the coal at Tilmanstone, Snowdown, and the Shakespeare cliff. Other shafts have also been sunk to varying depths, namely, at Guilford and Stonehall; at Wingham and Woodnesborough a considerable amount of plant has been erected, and the shafts have been sunk a few feet to bedrock. The colliery at

Tilmanstone has three vertical circular shafts of 14, 18, and 19 ft. diameter in the clear, respectively. They are brick-lined and tubbed throughout. They are sunk to a depth of 1600 ft. from the surface, the workmanship being first-class in every way. Cast-iron tubing has been inserted from 1135 to 1235 ft. in all three shafts for the purpose of excluding large feeders of water. For the first 50 ft. the cast-iron segments were $2\frac{1}{2}$ ft. deep and for the last 50 ft. they were 5 ft. deep; 9, 11, and 12 segments to the circle were used in the 14, 18, and 19-ft. shafts, respectively.

The whole of the tubing was inserted from a hanging wedging curb, to which the tubing segments were bolted ring by ring by means of their internal flanges. The horizontal and vertical joints of the segments were planed, a joint being made by $\frac{1}{8}$ in. lead sheeting. The bolts were fitted with conical steel and conical lead washers. When the water-bearing strata, which consists of sand beds overlying the Coal Measures had been passed, and hard coal strata were reached, a second wedging curb was built, so that the water was entirely excluded from the shafts. The space behind the tubing was filled with cement grout. The surface plant is generally up-to-date and well arranged. The winding-engine at No. 1 shaft is by Markham & Co., Chesterfield. A pair of 32-in. cylinders by 72-in. stroke fitted with Cornish inlet and Corliss exhaust-valves, steam-reversing gear, Whitmore steam-break and over-winding prevention-gear, inlet-valve controlled by Hartnell governor, a 20-ft. diam. cylindrical drum by 10 ft. wide. The engine-house is brick-built, with a tiled roof supported by steel principals. The winding-rope is lock-coiled $1\frac{1}{2}$ in. diam. The winding-engines at No. 2 and 3 shafts are in pairs of 30-in. and 60-in. cylinders. Capstan-engines are provided at all three shafts. At No. 2 shaft there are specially large sinking-pump capstans, each winch capable of lifting 40 tons on single purchase, the drums carrying about 4000 ft. each of 2 in. diam. rope.

The head-gears are of latticed steel and of timber. That over No. 1 shaft is latticed steel 60 ft. high, fitted with a pulley-lifting gantrey and 16 ft. diam. pulleys. Of the Lancashire boilers, eight are 30 by $8\frac{1}{2}$ ft. and two 28 by $7\frac{1}{2}$ ft., fitted with super-heaters. They are partly fitted with Erith under-feed stokers, and forced draught. Weir feed-pumps and feed-water heaters are used. The water from the shaft after settlement is suitable for boiler use.

The ventilating fan is of the Sirocco type and 5 ft. diameter. As yet no gas has been

detected, and consequently only a small fan is required. Locked safety-lamps by Ackroyd & Best are employed throughout, magnetically locked, and electrically lighted.

The pumping-plant consists of the following: At the 600-ft. inset there are four horizontal ram-pumps, three being compound-steam pumps having cylinders 22 by 38 in. direct-coupled to 14-in. rams, and one being a high-pressure with a 38-in. cylinder and 14-in. ram by 36-in. stroke. These pumps were used in sinking and are now practically idle. At the 1140-ft. inset there are three horizontal ram-pumps of compound straight-line pattern 19-in. and 32-in. cylinders, 12-in. ram, and 36-in. stroke. Each pump is capable of raising 500 gal. per min. to a height of 600 ft., and two Globe jet-condensers are working in conjunction with these pumps, which are stand-byes. In addition to the above at this inset there are three Sulzer six-stage high-lift turbine-pumps each capable of raising 1000 gal. per min. against a manometric head of 1300 ft. Each pump is connected by a flexible coupling to A.E.G. motors, the current being three-phase 3000 volts 50 periods. The water is raised to the surface in one lift through 10 in. pipe-columns arranged in duplicate. At the bottom of the shaft there is a vertical Sulzer four-stage capable of raising 1200 gal. per min. against a manometric head of 870 ft., driven by a 500 B.H.P. vertical type motor.

These heavy pumping sets give an idea of the large body of water that must be kept under control.

The feeder encountered in the sand that forms the junction beds on entering the Coal Measures gave about 2000 gal. per minute. Although this water was tubbed back, it was not sealed, but conducted by several pipes to the pump-suction pits in the 1140-ft. inset and thence pumped to the surface; so that there is practically no pressure on the tubing.

The depth of these shafts is 1600 feet. The Coal Measures were entered at a depth of 1172 feet. The landing is at a depth of 1550 ft., allowing for a 50-ft. sump. The coal seam that is being developed is known as the Beresford seam. It has the following section:

| | Ft. | In. |
|------------------|-----|-------------------------|
| Shale Coal | 1 | $4\frac{1}{2}$ |
| Coal | 1 | 5 |
| Parting | | 0 |
| Coal | 1 | 0 |
| Parting | | $1\frac{1}{2}$ |
| Coal | 1 | 2 |
| Parting | | 5 |
| Coal | | 6 |
| | | 5 ft. $\frac{1}{2}$ in. |

The coal is of a very friable nature, yielding about 75% of small coal. It is also a rather dirty coal by reason of the defined partings, and also because of thin threads of dirt in the coal. The roof is good and suitable enough for long-wall methods. This is shown in the section as a 5-ft. seam of coal; for, like most seams proved by bore-holes, the section is misleading. The workable coal is 3 ft. 7 in. with two partings. The analysis of the coal shows it to be a really good steam-coal; and that it undoubtedly is, as a small coal. It is much too tender to be placed on the market as 'large steam.'

The selling price at the time of my visit was 13s. 6d. per ton of small coal. This, one would think, should be a remunerative price, and, from inquiries made among some of the consumers, it appears to give satisfaction at that price.

From the bottom of the shaft pairs of levels have been driven east for a distance of 520 yards, and west 580 yards, 60-yd. pillars being left between the roadways. Two pairs of headings have been driven north, one on the east and one on the west side of the No. 3 shaft, and the coal workings in this direction now extend about 600 yards from the shaft. The full dip of the seam is about one inch per yard. A shaft-pillar has been left, 560 yards across and octagonal in shape.

The shafts cut the coal on March 12, 1913, the first coal being raised from the opening levels in April. Within a year of this date the output had reached 540 tons per day, but on April 1, 1914, a heavy feeder of water broke-in from a fall in the north working face, estimated at 1400 gal. per min.; the water drowned the whole of the underground workings. It took six weeks to get the water under control, so that the men could go back to some of the faces. The output at the time of my visit was only 240 tons per day. Much work had still to be done to re-open the rest of the mine.

The accident was probably due to the close proximity of the heavily watered strata resting on the Coal Measures, for there is only 376 ft. between the coal seam and these overlying beds. This is a very serious matter for the future working of the seam, for at any time a heavy fall, or a line of fault, may permit the water to enter, with consequences disastrous to a mine already too heavily burdened with water-feeders. In fact, the management recognizes the restriction such conditions impose upon their methods, which have been successfully changed from long-wall to double-stall, and finally to pillar-and-stall with little

chance of eventually robbing the pillars, a system that is too much like all development and no stoping in a metal mine. It does not appear at all likely that this seam can be mined at a working profit, and, of course, there is much less chance that it could earn interest on the capital outlay. It seems clear that the shafts must be sunk to the lower seams, which are proved by the Barfreton bore-hole to be between 2200 and 3000 ft. deep. It then becomes a question as to the amount of new capital necessary, and whether the information



STONEHALL COLLIERY.

gained from the core in the bore-hole proves the seams to be of good enough quality to warrant the extra expenditure. Large capital outlay demands big outputs at a cheap working cost. Such conditions are usually fulfilled where two or three seams are sufficiently close together to be worked from one bottom by means of cross-measure drifts, or at least where one seam is sufficiently thick to yield at least 6000 tons per acre of coal that does not require cleaning.

Snowdown colliery, as will be seen by the map, is situated about $2\frac{1}{2}$ miles west of Tilmanstone, 9 miles from Dover, midway be-

tween Adisham and Shepherdsweil railway-stations, and is connected to the South Eastern & Chatham Railway by a siding. Two working shafts, each 18 ft. diam., were first sunk to the Beresford seam, which was struck at a depth of 1500 ft. One of these shafts was continued and struck the 'Snowdown hard' seam at a depth of 2236 ft.; the depth of the shaft at the time of my visit being 2287 ft. The water encountered in the junction sand at about 1300 ft. was effectually excluded by underhung tubbing of the internal flange-bolted type similar to that at Tilmanstone, as already described.

The surface equipment is similar to that of Tilmanstone.

The water problem at this mine is not serious; a Sulzer pump in the Beresford seam of 250 gal. per min. capacity raises all the accumulated water in eight hours, and delivers it to the pump at the 720-ft. inset and thence it is thrown to the surface.

The section of the Beresford seam differs considerably from that at Tilmanstone, in that the seam is much split by partings of varying thicknesses, so much as to lead one to think that the shafts have been sunk in a very disturbed area; and unless and until the workings get beyond this locality of disturbance profitable working is impossible. The coal is of much the same quality as at Tilmanstone, very friable and rather dirty.

The seam has been opened out to the south-east side for about 440 yards from the shaft, and to the northwest for about 200 yards.

The following sections taken in the face of the north and south districts will be of interest; also a section taken in No. 3 level at 50 yards from the shaft will show the irregularity of the section:

| NORTH FACE | | SOUTH SIDE | | No. 3 LEVEL | |
|------------|-------------------|------------|--------------------|-------------|---------|
| In. | Bedding | In. | Bedding | In. | Bedding |
| 1 | band | 1 | band | 19 | coal |
| 18 | coal | 19 | coal | 30 | parting |
| 4 | parting | 1 | parting | 56 | coal |
| 22 | coal with parting | 26 | coal with parting | 69 | shale |
| | | 42 | coal with partings | 8 | coal |

The method of working is long-wall, but the roof, which is full of joints, gives much trouble and is difficult to hold, requiring highly skilled miners and timber-men. No cogs are used in the stall-roads; the use of them would probably be of much service.

The seam called the 'Snowdown hard,' recently struck in sinking the shaft at a depth of 2236 ft., is a fine good strong coal of excellent quality of the following section:

| | |
|--------|------------|
| 12 in. | coal |
| 7 in. | stone bind |
| 24 in. | coal |

Much depends on this seam for the future of this undertaking, but, it must be said, good as the quality of the coal appears to be, it is a thin seam with a parting of a thickness that is derogatory to cheap working.

Shakespeare.—This colliery is situated at the foot of the Shakespeare cliff on the sea-shore alongside the South Eastern railway, about two miles from Dover and five from Folkestone. The site is that of the vertical bore that was made in connection with the Channel Tunnel. Sinking was commenced in 1897. The original shaft was abandoned in 1900 at a depth of 600 ft., by reason of the excessive water at that time. Two other shafts have been sunk to a depth of 1622 and 1632 ft. respectively, the former being 14½ ft. diam., the latter 18 ft. diam. The Coal Measures were entered at 1120 ft. and a 20-in. seam was struck at 1275 ft. Sinking was continued to the present depth of 1632 ft., where a 24-in. seam of strong clean coal of good steaming quality was cut. Heavy inflows of water and running sand were encountered when sinking through the junction beds. The No. 2 shaft, which was sunk originally 18 ft. diam. as far down as 1100 ft., was continued by the Kind & Chaudron boring process to 1165 ft., to a solid bed that necessitated a reduction of the size of the shaft to 14½ ft., this being the largest size of tubbing-rings that can be used by this method. The tubbing was carried right up to water-level within 60 ft. of the surface, the space between the original brickwork and tubbing being filled with concrete. This is a costly process; for it not only reduced the diameter of the shaft but added enormously to the capital expenditure. The colliery is well equipped with surface machinery but the underground developments are practically nothing. There is a seam at 2200 ft. said to be 52 in. thick, to which it is intended to sink. It hardly needs to be stated that a 2-ft. seam of coal at this depth is not a profitable proposition, having regard to the enormous capital expended, and the necessary high working cost.

Other Collieries.—Having dealt with the collieries that have already reached the coal, it remains to mention the remaining collieries that are either sinking or that having reached a certain depth are idle for the time being.

At the Guilford Colliery there are three shafts, one being used as a colliery well 309 ft. deep. The two others are of 18-ft. diam.; these have been sunk to 1270 ft., to within 100 ft. of the Coal Measures, and just above

the junction beds. Sinking through the chalk, inflows of 300 gal. per min. were excluded by means of cement walling. Tubbing was used through the Hastings beds. An inset was driven at the bottom of the shafts and a 3-in. bore-hole was sunk. The junction beds were struck at 1345 ft., and an inflow of 600 gal. per min.; the standing pressure at the top of the bore-hole is 211 lb. per square inch.

These shafts are standing idle for want of capital. The water has accumulated in the shafts to the 615-ft. pump-house inset, to which depth it is kept down by suction water-barrels. The surface equipment, winding-engines, boilers, etc., are all in good order and adequate for a substantial colliery.

but I gathered that the process was not wholly successful.

General Results.—Having sufficiently described, for the purposes of this article, the collieries that have reached the coal, are sinking, or are standing idle, it remains to refer the reader to the map, from which he will infer the spheres of influence of the various companies or syndicates. It would be beyond the scope of this article to deal with the share capital and finance of the various companies. Suffice it is to say that compared with colliery enterprises in other parts of the Kingdom the working collieries are heavily burdened with capital. The operations of the Anglo-Westphalian Syndicate have so far been confined



SNOWDOWN COLLIERY.

The Wingham Colliery has two shafts of 19 ft diam., 50 ft. deep and bricked. A surface equipment of good winding-engines, boiler, power-house, etc., is available.

The Woodnesborough Colliery consists of surface equipment only.

The Stonehall colliery is financed, I understand, by French people; at the time of my visit the work was proceeding with much despatch, but since the war the work has been brought practically to a standstill. The colliery was being equipped with most up-to-date plant. The sinking of two shafts, 20 ft. diam., had only just been begun. The water from the chalk in No. 2 shaft was estimated at 1100 gal. per min. At the outset of sinking the cementation injection process was adopted for keeping back the water down to 300 ft.,

to bore-holes that, with the exception of Chislet, are thought, by many geologists, to be north of the coalfield. This syndicate has a strong board of English directors supporting a German director; prior to the war at any rate the prospecting work was controlled by German geologists; and as their operations are so contiguous to the estuary of the Thames it would be well that their work should be examined by the authorities in search for gun emplacements and similar surprises.* The bore-hole at Chislet struck a 4-ft. seam at 1116 ft. and entered the limestone at 1604 ft., passing out of it at 1842 ft. At Chitty the Coal Measures are tilted. The Betteshanger area is in the neighbourhood of Deal. The bore-hole at Betteshanger shows

* This, we understand, has been done.—EDITOR.

a good section of coal seams, probably the best in Kent. The Coal Measures are entered at 1100 ft., the following seams having been struck :

| DEPTH | COAL |
|-------|-------------------------|
| Ft. | Ft. In. |
| 1208 | 2 6 |
| 1504 | 2 — |
| 1813 | 4 5 |
| 1926 | 2 10 |
| 1975 | 5 — |
| 2150 | 3 6 |
| 2364 | 4 1 |
| 2403 | 3 — |
| 2513 | 2 7 |
| 2562 | 4 6 |
| 2592 | 2 3 |
| 2632 | 7 6 |
| 2911 | Carboniferous limestone |

The scope of the Channel Collieries Trust and the Channel Colliery Trust and Valley Syndicate is indicated roughly on the plan. The only coal exploration by the former company is a bore-hole northeast of Dover known as the Bere Farm. This bore-hole in July last was down 2001 ft. and appears to have entered the Coal Measures at 1360 ft. from the surface ; it has struck the following seams of coal :

| DEPTH | THICKNESS |
|-------|-----------|
| Ft. | In. |
| 1448 | 10 |
| 1504 | 10 |
| 1532 | 3 |
| 1586 | 10 |
| 1691 | 28 |
| 1991 | 20 |

Bore-holes are being put-down at Lower Standen and Elham, and were down in July 1002 and 471 ft., respectively, but up to that date nothing of value had been proved.

Bores have been completed at Farthingloe and Abbott's Cliff. These were primarily put down to test the extent of the millet-seed iron ore in the Oolite as proved in the sinking at Dover. This ore is similar to that being worked in the Oolitic strata of Wiltshire. No further information concerning these operations is available.

By far the largest area of the coal-field belongs to the Kent Coal Concessions, with which Arthur Burr and his son, Malcolm Burr, have been so long associated. The area is about 60,000 acres, of which 7391 acres are freehold. The leasehold is controlled by some 200 leases and 40 options.

The following acreage is sublet by the Kent Coal Concessions :

| Colliery | Acres |
|----------------|-------|
| Tilmanstone | 2200 |
| Snowdown | 2000 |
| Adisham | 2000 |
| Stonehall | 1500 |
| Wingham | 1500 |
| Woodnesborough | 1500 |
| Guilford | 4294 |

The terms of these leases are so onerous as to strike at the very life of the Concessions company. The dead rents run from 5s. per acre for the first year, 10s. for the second,

20s. for the third, and 40s. for the fourth year. The royalty is generally one-fifteenth of the selling price, or £35 per foot of coal per acre. It is said that these dead rents amount to some £40,000 per annum. This company started with great hopes and expected to have been paying royalties on the coal from their collieries, into which the dead rents would have merged, long before the heaviest dead rent payable on the fourth year would have matured, and they also had hoped to have disposed of the balance of the areas to subsidiaries. The position now is, or was last July, an impossible one.

The Coal.—Before closing this paper a word must be said as to the analysis of the coals already put on the market. The following is a result of a test made at the Tilmanstone power-station with large coal from the Beresford seam at Snowdown colliery ; from which it will be seen that the quality of the coal is good, disregarding the physical qualities of toughness, cleanliness, and thickness of seam :

DETAILS OF TEST

Quality of coal used, Snowdown colliery, Beresford Seam, large coal.
Babcock & Wilcox boilers, hand-fired, induced draught.
Heating surface of each boiler, 4020 sq. ft.
Grate area of each boiler, 76 sq. ft.
Steam pressure, 200 lb. per sq. in.
Temperature of super-heated steam, 550 to 560° F.

ANALYSIS OF THE COAL AS GIVEN BY G. LLOYD JONES, PRINCIPAL OF WEST HAM TESTING LABORATORY, AND AS PUBLISHED IN THE ELECTRICAL REVIEW OF FEBRUARY 28, 1913.

| | Above shale band. | Below shale band. |
|---|-----------------------------------|-----------------------------------|
| Volatile matter..... | 27'98 | 28'26 |
| Coke..... | 70'34 | 69'76 |
| Ash | 7'20 | 6 11 |
| Fixed carbon..... | 63'14 | 63'65 |
| Moisture (hygroscopic)..... | 1'68 | 1'98 |
| Sulphur (separately determined)..... | 1'32 | 1'29 |
| Calorific value (as dried) | 13,990 B.T.U's. | 14,180 B.T.U's |
| Net effective calorific value (as fired)..... | 13,316 B.T.U's. | 13,454 B.T.U's. |
| Evaporative power (as fired) ... | 13'79 lb. water from & at 212° F. | 13'92 lb. water from & at 212° F. |

Duration of test : From 11 a.m. on March 5 to 6-35 p.m. on March 6, 1913. =31 hr. 35 min.
Quantity of coal used 60,452 lb.
Coal burnt per hour 1,919 lb.
Total units generated 26,764

COMPARISONS

| | Welsh coal | Snow-down coal | Difference in favour of Snow-down coal |
|---|------------|----------------|--|
| Superheat obtained | 550° F. | 560° F. | 10° F. |
| Temperature of feed-water | 230° F. | 250° F. | 20° F. |
| Pounds of coal per unit generated | 2'30 | 2'25 | '05 |

In conclusion, I cannot report assured success at any of the collieries. There have been numerous drawbacks and difficulties, many of which have been overcome at a sacrifice of time and money. The War doubtless will still further retard development, so that it will probably be some time before there is a successful colliery undertaking able to pay dividends in the Kent coal-field.

INTRUSIVE PRESSURE OF MINERALIZING SOLUTIONS.

Rarity of cavities in rocks. Formation of a mineral district. Effects of rock stresses. Causes of intrusive pressure.

By BLAMEY STEVENS.

THIS is a subject in which but little interest has been taken. None the less I think it an important one; the more I have studied it the greater has its scope proved to be. In this article I wish to accentuate some of the general conclusions reached, and, if possible, to arouse the more active interest that I think should be given to phenomena so intimately connected with mining.

When one looks back from a more to a less advanced state of science the wonder seems to be that the old ideas were held at all. Taking the present subject as an example, we have long been content to suppose that filled veins were formed in cavities of faults and other fissures which had been gaping open, waiting for the filling solution to come along and deposit its quartz and mineral content. And yet our experience in mines has taught us that we hardly ever find faults with the cavities in them big enough to store a single ton of ore. Caverns eaten in limestone are practically the only exception.

Strange to say, also, we have for a long time been used to considering most of the smaller dikes of igneous rock as forcibly intrusive, that is, as having forced apart the rocks for themselves and not having absorbed them into the magma.

It is only a slight advance to the consideration of mineral solutions as forcibly intrusive, as having opened up their own cavities. The wonder seems to me to be that this advance has been so long delayed. Some American geologists, having in view only the character of the filling matter, tried to show that pegmatite 'veins' graduated into granite dikes. Then some deep-seated mineral deposits were gradually instanced as possibly formed from igneous emanations under pressure.

It became evident to me about this time that the intrusive pressure was rather the rule than the exception, because exactly this explanation was necessary to fill a gap in the contemporary theory of the formation of filled veins. In order to allow room for the veins it is necessary that the rocks should have con-

siderable elasticity. Calculations have shown, however, that the elasticity of rocks, as determined experimentally, is quite enough. Numerous other exact considerations also fit exactly into the theory.*

In the sliding of faults it is no doubt true that cavities are formed, but our experience with stopes shows that these are closed up again by the caving of the walls and by the accumulation of mud, &c., in what may be considered in geological time as merely a moment.

A mineral district may be considered in a general way as having been the seat of a single spring of mineralizing water. The ground below the first few hundred feet is close, compact, and practically impervious, but contains faults and other planes of weakness. Forcing these apart, in some places just enough to form small passages, the solution gradually rises to less depth. Where there are no planes of weakness, the rock has to be riven or rent apart by the pressure of the solution. When the small passages become nearly choked with the material deposited by the solution, the pressure accumulates more and the size of the opening is thus enlarged.

When the rock has become too tight in this locality another opening is started, some distance away, where the country has not yet become tightened. As the filling of the district with quartz veins progresses, the constitution of the veins first filled may differ considerably from that of the last filled, because the composition of the solution is altering.

Sometimes the pressure required to open the small cavity necessary for the passage of the solution may be enough to have forced open a much larger space in some slightly lower rock of different texture. In this case the walls are apt to cave-in and fill the cavity with pieces of the wall-rock. Quartz and other mineral from the solutions may then fill the interstices.

Under other conditions replacement of the

*The Laws of Igneous Emanation Pressure. Trans. Am. Inst. M.E. Vol. XLIII., p. 167 (1912).

wall-rock with vein-matter may take place in such a manner as to shrink the bulk of the rock. This may relieve the intrusive pressure and bring about the caving and general settlement of the ground so as to create gouge-matter and slickensides in association with the quartz. The caving of the rock may in such cases facilitate further replacement.

It might be said that replacement veins could be formed without any intrusive solution pressure. It is a fact, however, that many of them show the effects of such pressure in the rending of the cavities. When, for example, as at Leadville, a rent follows a horizontal plane of weakness, the pressure must have been at least that due to the depth of rock beneath the surface.

Some of the greatest mineral deposits of the world are formed in rents that have been broken open by the intrusive pressure of the solutions. Such for example are the Homestake lode in South Dakota, the Perseverance in Alaska, and the Broken Hill in New South Wales. But great faults have also been opened out by intrusive solutions and mineral deposited in them. Such for example is the Comstock vein in Nevada.

Rents are in general distinguished from fault-fissures by their greater verticality and straightness, but there are vertical faults and crooked rents. The displacement of the faults is sometimes noticeable, but the presence of some selvage or slickenside is no safe criterion. In many ways a rent vein may be compared to some dikes. The magma filling of a dike, however, generally supports the walls intact, while the igneous filling of a rent allows them to fall off so that in some places the cavity becomes larger, and in others it is almost blocked with debris. There are also other distinctions.

It is not to be presumed that the great pressures that solutions attain are always due to their igneous origin. These pressures may just as well be brought about by horizontal thrusts, which crush and crumble the underlying rocks, thereby diminishing their interstitial water-filled spaces. Cavities may indeed have been forced open simultaneously, and in the same rocks in which the crumpling takes place. Such, for example, are the saddle-reef cavities in the Bendigo district of Australia.

Pressures of intrusive magnitude may even be formed by the mere weight of the overlying rocks and flows of solution at these pressures kept up by the diminution of the interstices that in great part constitutes the pheno-

mena of cementation. This, for example, is believed to be the source of supply of most massive salt deposits.

While appreciating the tendency to conserve the more simple of two explanations, I cannot but help thinking that a proper conception of the true actions of mineralizing solutions would in the long run be of most value to the average mining man. It may indeed be that the born miner does not need to crystallize his knowledge and experience about absolute scientific truths. The trouble is, however, that only one in a great many of us is a born miner, while practically all are capable of appreciating and applying scientific truth.

Electrolytic Iron is now being made on a commercial scale according to the patents of La Société le Fer, of Grenoble, France. By this process sheets and tubes can be made without any rolling being required. The iron as deposited in the electrolytic cell is brittle and the pipes and sheets have to be subjected to an annealing operation. If deposited as ingot, the brittleness is an advantage when the iron is to be melted. This iron is extremely pure and of regular constitution and quality, and can compete with the best Swedish iron. A characteristic analysis is as follows: Carbon 0'004%, silicon 0'007%, sulphur 0'006%, and phosphorus 0'008%. The pig iron used in the manufacture of this sample was: Carbon 2'35%, silicon 1'31%, sulphur 0'07%, and phosphorus 1'07%. The process consists in the use of a revolving cathode, and a neutral solution of iron salts, maintained in a neutral state by the circulation of the solution over the surface of the iron. The bath also receives periodic additions of a depolarizing medium such as oxide of iron, the object of which is to eliminate in part the hydrogen deposited on the cathode. The current-density employed is high, being 1000 amperes per square metre. The yield is about 2 tons per kilowatt-year. The Bouchayer & Viallet company hold licences to manufacture sheets and tubes according to these patents, and are making tubes of unusual thinness, being from 0'1 to 6 millimetres thick, 4 to 8 inches diameter, and 12 ft. long. It is notable that at present it is difficult to manufacture thin tubes of this character of constant thickness. These tubes will withstand considerable pressure. Thus an annealed tube 0'75 millimetre thick and 4 in. diameter subjected to an internal pressure of 1200 lb. per sq. in. underwent a permanent deformation without any fracture.

ZINC AND BRITISH TRADE

By H. M. RIDGE

IN the August and September issues of *The Mining Magazine* some interesting editorial articles containing much useful information on zinc smelting were published, but the subject is of such importance at the present time that I must ask the indulgence of the reader for re-stating many facts that have already been mentioned in these pages.

Owing to our depending in normal times upon the Continental smelters for supplies of spelter (crude zinc), a disagreeable shortage was experienced when war broke out. At the same time acute distress was caused in some of the mining districts where zinc ores are produced owing to cancellation of contracts for the sale of the zinc concentrate. The position seemed particularly serious because zinc is extensively used in connection with the manufacture of ammunition, and for making galvanized iron, of which a large tonnage is required for temporary barracks.

In 1913 about a million tons of spelter was produced, but of this only 58,214 tons was made in Great Britain, while consumption was no less than 223,000 tons. In other words, only 26% of the metal consumed was produced at home, the balance being obtained from the Continent, most coming from Belgium and Western Germany, although in spite of the big distance and high freights an appreciable amount was obtained from Silesia.

Let us briefly consider the history of spelter production: Brass containing up to 27% of zinc was already made by the Romans who utilized it for coinage, but probably that brass was produced by the reduction of carbonate ores in contact with metallic copper. In the Middle Ages spelter appears to have been made in China, but in Europe the art was first practiced in the 18th century, when several small reduction plants were operated in South Wales. The method used was the same we employ today, but important improvements have been made in detail. The ore was mixed with coal and heated in a closed vessel till the zinc oxide was reduced and the metallic zinc volatilized. Early in the 19th century treatment of the zinc-ore deposits of the Altenberg on the frontier of Belgium and Germany commenced, and about the same time, quite independently, smelting of local ore was started in Upper Silesia. Some fifty

years later it became necessary to treat sulphide ore and much damage was done to the vegetation of the surrounding districts through the emission of sulphur fume. After considerable technical discussion and some experimenting, it was found practicable to roast the ore in muffled furnaces and to utilize the sulphur for the manufacture of sulphuric acid; on the Continent the erection of new works or the extension of old plant is not permitted unless acid is made and noxious fumes are avoided. Based on modern experience there is no difficulty in doing this, and appreciable profits are derived from the sale of the acid, although the capital outlay required for the extra plant is important. At first Hasenclever furnaces were used for roasting zinc-blende, but mechanical furnaces are gradually being adopted because not only is the cost of roasting appreciably reduced but the product is better and more uniform.

Zinc is obtained from calamine and blende. Calamine is carbonate of zinc and the treatment of this ore is particularly easy because its reduction is effected at a lower temperature than that of zinc-blende. The silicate of zinc, which in the trade is included under 'calamine,' although in mineralogy it is known as smithsonite, behaves in the furnace similarly to the carbonate. The blende consists of the sulphide of zinc mixed with more or less iron sulphide. The proportion of zinc to iron varies widely in different ore deposits. From 25% to 33% of sulphur is present in the ore, and this has to be removed by roasting before the mineral can be reduced. During the last 20 years, calamine has become scarcer and more expensive, and at the same time rapidly increasing quantities of complex zinc ores have been offered by the mining companies. In addition to their zinc contents these complex ores carry other metals in sufficient quantity to make their extraction desirable, although this complicates the treatment. Lead and copper sulphides are so intimately associated with the blende that they cannot be mechanically separated and the metals have to be recovered one after the other by chemical or furnace treatment. The complex ores generally carry sufficient silver and gold to more than compensate for the extra expense incurred in their extraction.

Copper-bearing blende causes comparatively little trouble, because when the zinc is distilled from the roasted ore, the copper remains in the residue and acts as a collector for the silver and gold. When treating zinc ore carrying lead, greater care and skill are necessary. The retorts in which zinc is distilled are made of fireclay, which is attacked by the lead in the charge unless proper precautions are taken, and the attack is rapid if an appreciable percentage of sulphur is left in the roasted ore, because lead in conjunction with iron sulphide eats into the fireclay like hot water dissolves a lump of sugar. In smelting leady zinc ore the silver and gold accumulate in that portion of the lead which remains in the residue and can be recovered by a further treatment.

The world's zinc production has doubled since 1900, and without treating complex ores it would be impossible to maintain the present supply. In Silesia, where extensive orebodies are being mined and where some of the mines can see up to 100 years of life ahead of them, it has been found necessary to treat the low-grade ores as well as those of higher metal-contents, so that ore containing 15 to 20% of iron is now sent to the smelters. In Western Germany and in Belgium local ore supplies are insufficient to keep the smelting-works going and a large proportion of the material furnished is imported from abroad, mainly from Australia, Mexico, and North Africa. Last year Germany imported 308,335 tons of zinc ore. The newer smelting-works have been erected close to tidal water or on navigable rivers so as to reduce freight-charges. Coming nearer home, we find many of the zinc mines in Wales shut-down, while most or all of the ore produced in Cumberland belongs to a foreign company, and is shipped to Belgium for smelting. British smelters produce in some cases an excellent grade of metal, but most of them have confined their attentions in the past to the treatment of calamine and straight blende free from other metals and have not worried about the by-products, so that the Continental works have provided the only market for complex ores and have been able to purchase these on their own terms and without competition, in spite of the fact that a large proportion of the ore is mined in the British Empire.

At Broken Hill, the production of zinc concentrate was started in 1899 and has increased so rapidly that last year 530,000 tons was produced. Apart from about 25,000 tons that is smelted by the Proprietary Company at Port Pirie, and by the Central Zinc Company

at Seaton Carew, the whole of the material is shipped from Australia to the Continent and is smelted in Belgium and Germany, and to a small extent in Holland, yielding over 190,000 tons of spelter. It will be noticed that if smelted here this ore would alone be sufficient to supply the home market with metal and at the same time afford employment for a large number of work-people. Early in August the buyers notified the mines of their inability to carry out their contracts, and as the mining companies were unable to sell their concentrate the mines had to be closed-down. It is difficult for anybody to realize fully what this stoppage of work means unless he has been there. The town with its 40,000 inhabitants is entirely dependent on the mining industry, and as no other occupation is available acute distress was felt soon after the mines stopped work. The State Government assisted the municipality considerably and relief works have been started; some of the mines are conducting operations on a reduced scale and are working every second week so as to make their cash resources last as long as possible and to provide work for their men, but as smelting facilities for the zinc concentrate are not available the produce from the mines has to be stored because it is unsaleable at the moment. The treatment requires skill and experience, but presents no difficulty; Broken Hill concentrate has been smelted on a large scale for so many years on the Continent that the methods have become standardized. The ore is heated and oxidized in furnaces to which air is admitted and the sulphur is driven off as sulphurous acid, which is further oxidized and then condensed as sulphuric acid. One ton of ore yields 17 to 18 cwt. of strong acid, and as the sulphur does not cost anything because the ores must be roasted, the manufacture and sale of the acid leaves a good margin of profit, having mainly to compete with the acid produced from the burning of pyrite. The roasted ore is mixed with coal or coke, charged into fireclay retorts and heated until the zinc oxide is reduced to metallic zinc, which distils and is collected in fireclay condensers. A proportion of the metal passes uncondensed through these pipes and is allowed to cool without admission of air in an iron tube called a 'prolong.' The zinc vapour, which has not been caught in the condenser, settles in the prolong as fine dust, and, after being cooled and sieved to remove any globules of metal, this dust is filled into casks for sale as zinc-dust or 'blue powder.' The zinc contents of the blue powder realizes a higher price

than spelter; blue powder is extensively used in connection with the cyaniding of gold ores, the manufacture of artificial indigo, and in several other chemical industries. When leady ores are being treated, a good deal of lead is carried forward into the condenser with the zinc, and it was formerly considered necessary to re-melt and refine the zinc in a special furnace. I found that even when distilling Broken Hill concentrate with 15% lead this re-melting could be obviated by running the metal from the condenser into a suitable casting-ladle; the lead, being heavier than zinc, settles to the bottom; molten zinc can be poured off until almost pure lead remains; by this means up to half of the lead content in the charge can be recovered free from silver. The rest of the lead, as well as the whole of the silver, remains in the retort together with the ash from the reduction material, iron from the charge, and whatever other non-volatile impurities may be present. The whole of this together is called the 'residue.' Further treatment of the residue depends upon local conditions. If a lead-smelting furnace is directly available, the whole of the residue may be smelted with other lead ores and the carbon in the residue used as a reducing agent, but where this is not possible, the residue is enriched by means of wet gravity concentration in jigs and on tables in order to separate the argentiferous lead from the carbon and other materials present. A lead product is obtained rich in silver and usually carrying 30 to 40% of lead; this is smelted for argentiferous lead.

Zinc smelting was difficult formerly because skilled labour was required for many of the operations, which although simple in theory, had in practice to be carefully performed by hand labour. Roasting zinc ore in a hand-rabbed furnace is arduous; it requires skill and practice if the best results are to be obtained; the manufacture of gas-tight fireclay retorts six feet long with walls only $1\frac{1}{4}$ inches thick is a ticklish job; thorough mixing of the roasted ore with the reduction coal is essential if high metal-recovery is to be assured; only expert workmen can properly charge a zinc-distilling furnace, and good supervision is requisite if loss of metal is to be avoided. During recent years all these operations have been made much easier. Mechanical roasting-furnaces are now available and ensure that the ore is satisfactorily roasted and the sulphur more completely removed than was possible in the hand-rabbed furnaces. This is important because the presence of sulphur in

the roasted ore prevents the complete volatilization of the zinc. The fireclay retorts are now made in an hydraulic press working under high pressure; the retorts are dense and the walls thinner than when made by hand, so that the heat conductivity is improved and the retorts last longer. By mixing the charge mechanically, a higher recovery of zinc is obtained than is otherwise possible because each particle of zinc ore is brought into contact with a particle of coal, so that complete reduction is assured. Ingenious machines are being adopted for charging the distilling-furnaces, and here also the mechanical operation is more satisfactory; the retorts can be charged evenly, each of them being properly filled. A modern zinc-distilling furnace usually contains 64 or more retorts, so that the necessity of properly charging the retorts is obvious. Other important improvements have been made in recent years in the design of the furnaces; a consumption of two tons of coal for each ton of ore for heating the furnaces was formerly considered satisfactory, and I understand that even today 30 cwt. of coal is regarded as good practice in America, but largely in consequence of the rapid increase in price of coal on the Continent, efforts were made to reduce the coal consumption, and experiments pointed to the conclusion that Siemens regenerative furnaces could not compete with recuperative furnaces. The latter are built on the counter-current principle so that the air required for combustion of the fuel circulates round small brickwork flues that permit the exit of the waste gases; by this means the air is heated more uniformly than is possible in a reversing regenerative furnace. With the best design of furnaces fuel consumption does not exceed one ton of coal per ton of ore.

Apart from Broken Hill, large deposits of zinc ore are found in Tasmania, in Burma, and in other parts of the Empire, but in every case production has been stopped by the war. Supplies of zinc for the English market have been brought from the United States, but, as the American consumption is normally about equal to the production, we cannot permanently reckon upon obtaining large quantities of metal from there. No definite information is available as to the damage done during the war to the extensive smelting-works in Belgium, but it is obvious that these must suffer considerably, so that even when peace is concluded the smelting capacity on the Continent will probably be insufficient and new works will be required to cope with the demand.

FROM AMERICAN LETTERS.

The following extracts from letters to the Editor indicate the views of representative Americans.

I.

So far as I can see, my own feelings are no different from those of almost everyone not of recent German descent. They are that the Goths and Vandals have broken loose for what they could take from other people and exactly as they used to in the dark ages. We have had a vast amount of specious German reasoning and much talk of Russian plots in the Balkan states, but it all reduces in the long run to the belief in Germany that they could crush France once for all, and get away with the spoils. I have no doubt that the iron ore districts in northeastern France and Morocco, together with a ruinous money indemnity, were the chief objects immediately in view, along with the Belgian and Dutch seaports. I have heard the Germans talk at scientific congresses. They have cultivated assiduously a hatred and contempt for France that is amazing, simply amazing, when we hear it from university professors. We anxiously watch the papers day by day, in the prayerful hope that the Germans have attempted the impossible and that they will end in financial ruin. With all my heart I hope to hear German music on the soft pedal for the next 50 years. This result will be to the indescribable benefit of the world and would put us all back in the light after the outbreak of innate Teutonic barbarism.

II.

You may well be proud to be an Englishman. Your army has bucked up the firing-line on the Continent and if you can only manage to get men enough there in time the Germans will talk much less about the English as a kramernation,* which has for decades been their favourite expression. No one here believes they will win, but we fear it may be a long drawn-out fight. I am not against reprisals in kind for all that has been done in Belgium. If Cologne be taken, the cathedral, which, after all, is nearly entirely modern, should be razed to the ground as a scar on Germany that she will remember for all time. You may think me barbarous, but I believe in leaving a reminder of such a sort to make people think.

Everything here is quiet. It seems to me

*Nation of shop-keepers.

a period of consideration, a feeling that the old order has passed away, and that we do not quite know how to enter upon the new. Never in our time has there been such a day. No one is buying anything or starting any new work whatsoever, and many well established businesses are curtailing and cutting dividends. I was in the nitrate pampa when the row started, and came up a couple of days later from Iquique on a German boat. They dumped us at Arica, and the captain told me that he was ordered to stay there, in fact, could not move because he had neither money to pay his crew, to buy coal, or to obtain provisions. I understand that the German boats are all in the same condition; they are tied up all along the coast. In 48 hours there was a complete stand still of all German commercial matters of all kinds on the west coast, and not over a couple of days delay for English shipping. I don't wonder that the Germans want to get you out of the way.

III.

Please accept my thanks for the copy of the White Paper which you so kindly sent me. Your copy, however, was not the first received in this country, as the *New York Times* got hold of it and issued the English and German documents in pamphlet form on August 31, having previously published them in its own columns. I think I may say without fear of contradiction that the American people are almost a unit in favour of the Allies and opposed to Germany. While we all appreciate the wonderful industrial development which has gone on in Germany, we regret her militarism.

As you know, there is one thing that England must do if she expects to succeed in her manufacturing enterprises, and that is, she must have more technical training and less domination of trade-unionism. These are the points upon which the German champions in this country harp, and say that England's entering the war was not based on her moral character, but simply on account of her jealousy, due to the greater efficiency of Germany in her manufacturing and commerce.

Our last despatches show the Allies to be driving the Germans back. We all hope that this is not a mere flash in the pan, and that when the war is settled Germany will either become a republic or a constitutional monarchy like England.



DISCUSSION

Anaconda Smelting.

The Editor:

Sir—In your editorial in the September issue concerning the advances at Anaconda you referred to the large increase in production expected there as a result of improved recoveries, and ascribe this improvement to the developments described in my notes on the new reverberatory practice. As a matter of fact such improved recoveries are being achieved, but in quite a different field, namely in the wet concentration of second-class ores, and by the introduction of a leaching and precipitation process for which a large plant is now being built. Of these processes excellent descriptions have been given in the bulletins of the American Institute, by Messrs. Laist, Frick, Hayden, Aldridge and other members of the staff.

The interest aroused by the performance of the new reverberatory is not due so much to improved recoveries—though there will probably be a decrease in slag loss—as to the astonishing increase in furnace capacity and the reduction in fuel.

E. J. CARLYLE.

Sissert, September 30.

Lead Smelting.

The Editor:

Sir—In response to your request, I beg to say that the metallurgical method best suited to the treatment, under English conditions, of the Broken Hill lead concentrate, appears to me to be the following:

(1). Smelting the bulk of the 70% concentrate in large reverberatory furnaces of Silesian type so as to keep volatilization low, turning out as metal a maximum of 60% of the lead present and the balance (apart from fume) in the form of grey slag with 40 to 50% lead.

(2). Smelting the 'grey slag' together with the necessary fluxes and a proportion of the original ore, previously roasted and agglomerated, in an ordinary rectangular water-jacketed with syphon-tap, the fume from which is collected by passage through a bag-house.

Blast-furnace smelting being much cheaper than reverberatory, and the volatilization loss being of less moment when a bag-house has to be provided in any case, as much ore as possible should be handled in the blast-furnace. With a properly proportioned slag and comparatively slow running it is easy to smelt charges as high as 35% lead without abnormal fume losses.

The minimum most economical capacity for such a works then is determined by the tonnage that can be put through the smallest economical size of blast-furnace. Since a furnace about 36 by 84 inches or 42 by 84 in. will put through 100 tons of charge per day, or say 2500 tons per month, allowing for stoppages, of which a maximum of, say, 1000 tons might be roasted and sintered lead ore, say another 500 tons grey slag, 500 tons fluxes, and at least another 500 tons of fume, furnace-hearths and cleanings, foul slag, etc. This brings us to a capacity for the works of say 30,000 tons of Broken Hill concentrate or 20,000 tons of lead per annum.

The reverberatory part of the plant would consist of at least 10 long Silesian furnaces (8 to be always working) with suitable arrangements for removing grey slag in pots running on a track under the vaults. These might treat a total of 1500 tons lead ore per month, yielding 60% of the metal present. The remaining 1000 tons of ore would be mixed with the 500 tons of coarsely crushed fluxes (purple ore, limestone chips, crushed matte) and sintered for the blast-furnaces in Huntington-Heberlein pots or Dwight-Lloyd machines.

As to fume, that from the reverberatories would be condensed as thoroughly as possible by means of large chambers with installations of hanging wires; those from the blast-furnace by a bag-house after thorough cooling. The product might be either briquetted or mixed with the sinter charge. A Parkes desilverization plant on ordinary lines would be best combined with the works, although desilverization could be carried out elsewhere, if necessary.

Such a plant would be best situated near a coal-field with both water and railway transport. It might be on the Mersey, on the Dee, or the Tyne, or in South Wales. Its cost would vary according to the site and the general lay-out, but might be roughly estimated at somewhere in the neighbourhood of £45,000, including the desilverization plant, or £35,000 without, in which sum, however, nothing is allowed for site, quays, railway sidings, or other approaches.

Taking into account the desilverization plant complete, this would be equivalent to an outlay of say 50s. per ton of lead per annum, involving a tonnage charge of say 5s. on every ton of lead produced, allowing 10% for interest and amortization. For the smelting plant alone, without the desilverization, the charge for interest and amortization would amount, at the same rate of 10%, to 4s. per ton of lead produced.

HENRY F. COLLINS.

Cueva de la Mora, Spain, October 6.

Potash Salts in Spain.

The Editor:

Sir—During the last few weeks many inquiries have been made regarding the discovery of potash salts in northeastern Spain, near the town of Cardona, in the provinces of Barcelona and Lerida. No definite information as to the value of the find from a commercial point of view is available, but the Spanish government has sent a commission of engineers belonging to the Geological Survey to make an examination of the deposits. It is to be regretted that the only interest so far taken is in the hands of the German Potassium Syndicate, which controls the Stassfurt deposits, for if an English company could have secured the property an end might have been put to the German monopoly, which bears heavily on users in all parts of the world. From information gleaned during a recent visit to Germany, I believe that the district has been little prospected, and that there still may be a good chance of finding deposits outside the area acquired by the Germans.

In the hope of arousing some interest in potash deposits, I am sending you two sections showing the geology of occurrences in the Harz and in Hanover, where a large part of the drilling was done under my supervision. The first shows the Muschelkalk and the New Red Sandstone of the Triassic age, underlain successively by younger rock-salt, anhydrite, salt-clay, potash salts, older rock-salt, anhydrite, and stinkstein, of the Permian formation.

In prospecting, the place to find the potash salts would be under the salt-clay, which is impermeable to water, while the potash salts are extremely soluble. In localities farther from the Harz, the formations are much disturbed, as in Fig. 2, and it was a question

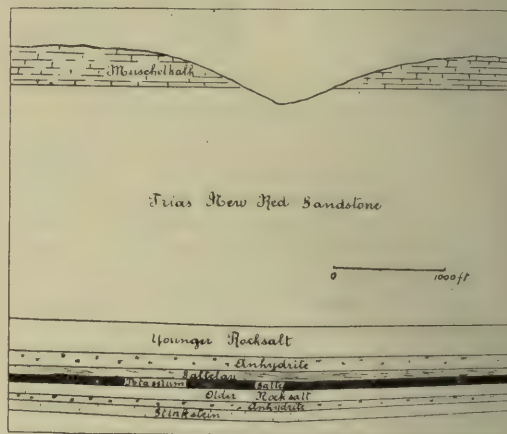


FIG. 1. HARZ TYPE OF POTASH DEPOSIT.

whether the potash deposits would be workable, but subsequent development gave better results than could have been anticipated from the bore-holes.

In prospecting for potash salts, special geological experience is required for the best disposition of the bore-holes and for the man-

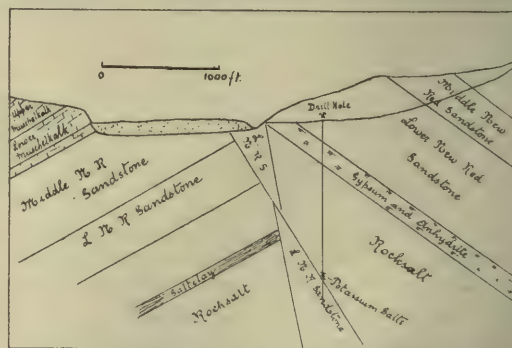


FIG. 2. HANOVER TYPE OF POTASH DEPOSIT.

agement of the plant. It is obvious that no surface indications of soluble salts would ever be found in countries where there is a rainfall, and often it is necessary to persevere with drilling to considerable depths.

One hole I put down traversed the rock-salt formation from a depth of 170 to 939 metres without striking potash salts. The spot for the hole was badly chosen, because this point was the top of a Permian syncline. It was covered at surface with a Tertiary terrain.

The salt had a steep dip and the bore may have passed through quite a narrow deposit of salt, parallel to other potash deposit. When boring, as soon as a salt deposit is struck, water cannot be used, and magnesium chloride must take its place. Salt is not soluble in this material. Every metre of salt core must be chemically examined, because rock-salt and potash salt are often much alike. Care should be taken to fill the holes, because any water entering would dissolve the salts and cause a caving of the mining area. Balls of baked clay are used for filling. They are stamped at intervals. Instructions should be given as to the number of clay balls per minute, and at what periods the stamping should take place. As regards shaft-sinking, the lining must be water-tight. The shafts are, of course, circular. Down to a depth of 70 metres masonry can be used, but if after this depth water is encountered, cast-iron tubing is necessary.

Germany has today, as already said, the natural monopoly of potash salts. No other countries have found them in large quantity. The salts are mined from depths of 300 to 800 metres. Over 5 million tons of potassium and magnesium salts was brought to surface last year, of which $3\frac{1}{2}$ million tons was kainite and sylvite. Over $1\frac{1}{2}$ million tons of 80 and 90% potassium chloride was consumed in the manufacture of potash, caustic potash, etc., and for fertilizers. Germany alone uses about $2\frac{1}{2}$ million tons of potash salts, North America nearly $1\frac{1}{2}$ million, and England only 53,000 tons.

E. MACKAY HERIOT.

London, October 20.

Technical Terms.

The Editor :

Sir—I have been interested in reading the discussions of technical terms in your magazine. In the September issue Mr. H. R. Sleeman writes concerning the terms used in connection with quantities and values of ore.

However much I agree with Mr. H. R. Sleeman regarding his use of the terms 'developed ore' as against 'ore in sight,' I cannot agree with the view he expresses regarding the reservations to be made when giving an estimate of developed ore. He says: "In so far, however, as certain patches of ore can be expected to be untouched by the development work and consequently never known or excavated, the probabilities are that the estimate made from results obtained in development work will, on the whole, be bigger as regards quantity than the ore actually excavated."

This sentence, I think, is contradictory because patches of ore, "untouched by the development work" and "never known," can never be included in the estimate of developed ore; consequently they cannot be the cause of a particular area giving less ore than estimated. On the contrary, the probability is that such patches, untouched by the development work, will be found by the subsequent stoping, if this is intelligently supervised, and will therefore rather have the tendency to make the tonnage extracted higher than the estimated extractable tonnage of developed ore.

C. NIELSEN.

Lillebo, Norway, October 10.

Metallurgy at Mt. Elliott.

The Editor :

Sir—In your issue of July you gave a description of a new water-jacket vaporizer together with a section of the furnace. It may be of interest to your readers to know that a similar device has been in operation at Mt. Elliott, North Queensland, for nearly four years, during which time the furnace has smelted ore containing about 20,000 tons of copper. The steam from the water-jackets is condensed in aerial coolers and the condensed water returned to the supply-tank.

A few practical points in connection with the scheme may be mentioned. The intake to the jacket requires to be below the tuyere-level, and the outlet at the top of the jacket. The outlet-pipes from the vaporizer to the aerial coolers must be above the highest point of the jacket, at least 4 inches above the top jacket. The size of the inlet and outlet pipes to the jackets should not be less than 3 inches in diameter, otherwise there is a likelihood of steam blocking the pipes and stopping the circulation. The vaporizing-drums must have sufficient steam-area above the level of the out-take water from the jackets into the vaporizer. The steam pipes from the vaporizer to the aerial coolers should be 8 to 12 inches in diameter. Each inlet and outlet pipe to the vaporizer must have a valve so as to close-off the water from any one jacket in case of the jacket wearing through. Mt. Elliott's experience was that a jacket was never burnt; it was simply a case of wear of the column of ore on the jacket, and the steel of any jacket that they took out was worn down to about $\frac{1}{8}$ inch and under, and mostly about 2 ft. above the tuyeres. They smelted about 140,000 tons of ore before having to take out a jacket for repairs.

As regards the automatic float-valve, the plan in your issue does not show how it is arranged, but it is a tricky valve, as Mt. Elliott proved by experience; owing to some sudden change in the furnace at times and a sudden rush of steam, Mr. Automatic instead of being a float because a steamoplane and cut-off the water-supply. So over three years ago Mt. Elliott's automatic went to another department and they built a tank and attached a float to the main water-supply, in order to keep a constant head of water in the tank, and conducted two pipes to the furnace vaporizing-tanks, with two regulating-valves. After a trial of a few days, by adjusting the supply-valves and watching the gauge-glasses on the vaporizers, they had no further trouble. Some of the original jackets that were installed are still in position, and over 160,000 tons of ore, plus flux, plus converter-slag and scrap, plus coke, has passed through the furnace. There is no buckle or twist in the jackets, and the original asbestos pug rammed between the jackets is as good as the day it was put in. The scheme is all right; it is a great saver of heat and water-consumption.

Another point that may be of interest to readers may be mentioned: At the commencement of the new treatment plant at Mt. Elliott there was not sufficient sulphur available to make a matte of low enough grade, their lowest grade being about 70% copper; and the question was how to convert it to 'blister.' If they tapped the matte into a ladle the bulk would chill, so they decided to build the converters as close to the furnace as possible (at the same time giving ample room between the furnace and the converters) and tap the high-grade matte direct from the fore-hearth into the converters in a blowing position; so that there was no turning-down of the converters to receive the charge of matte, and the converting of the copper matte commenced from the moment that the matte started to flow from the furnace fore-hearth, with the result that there was no difficulty to convert any grade of matte to blister copper so long as it would run from the fore-hearth. The skimmers after a day or two can judge to a hundred-weight the charge in the converter by the sound of the blast (the sound varies with the height of the charge in the converter) and they signal to the tapper on the fore-hearth when they have a sufficient charge. Two 8 by 6 ft. converters (acid-lined) have easily converted 800 tons of blister per month, and could have done more if the matte was available.

With further reference to tapping matte

direct to converters in a blowing position, it is cleaner and quicker, and after using it for over three years the management would not think of going back to taking the matte from the fore-hearth by ladle and conveying it to the converters. On low-grade matte the method shows to better advantage, as the matte will travel very much farther in a launder than high-grade matte, and the converter-stands can be spaced farther apart.

Fresh water-supply for the mine is conserved in concrete weirs built across a dry sandy creek about 6 miles from the mine. The weirs are keyed 2 ft. into the bottom of the creek and 6 ft. into the clay sides of the creek. The concrete walls are continued to the level of the top of the sand, so that when the flood comes, which it does about once a year, the flood-water flows right over the weirs but impounds about 25% of the water in the sand. If the weirs were brought higher than the top of the sand it would result in the water cutting a fresh channel in the clay bank and the weirs becoming useless. Water is a consideration at Mt. Elliott, but, as showing what can be done, they supply all employees with 3 gal. per day of fresh water; at least they are supposed to take only 3 gal., but this means nearer 5 gallons. In addition to the above they run the mine and smelter plant on a consumption of 20,000 gal. per day, which has been brought about by galvanized iron aerial coolers having ample area so as not to give any back-pressure on the engine.

QUEENSLANDER.

Mount Elliott, September 18.

Working Cost and Sorting.

The Editor:

Sir—In metallurgical reports, especially in those of the Rand mines, it is customary to report the working cost in terms of the tonnage milled, even where sorting is practised. Surely this is wrong. The sorting station is an integral portion of the mill, its costs should be debited to mill account, and the final working cost per ton should be based upon the tonnage delivered to the sorting station. If a contrary course is pursued a false idea of the working cost and profit per ton is given. In illustration of this I will cite some figures from the report of the New Modderfontein, quoted in your last issue. 537,600 tons were raised, from which 4.9% was rejected as waste, 511,290 tons going to the mill. The total yield was £990,354 or 38s. 10d. per ton milled, the working cost was £431,140 or 16s. 11d. per ton milled, and the profit was £559,214 or

21s. 11d. per ton milled. If, however, we divide the total cost by the number of tons raised we find that the cost per ton is 16s. 0 $\frac{1}{2}$ d. Doing the same with the total yield we get as the result 36s. 10d., the yield per ton raised. It will be seen that the profit per ton is, neglecting fractions of a penny, 20s. 9d. in place of 21s. 11d., the figure given.

By adopting this course some further instructive figures can be deduced bearing on the economics of sorting and the permissible value of the waste. Assuming for the moment that the mill has sufficient capacity and that the value of the waste is *nil*, we will suppose that the whole of the 537,600 tons raised is put through the mill without sorting. It is improbable that such a small quantity as the 26,310 tons per annum increase proposed would have any appreciable effect upon the milling cost per ton, so we may assume that the 537,600 tons is put through at 16s. 8 $\frac{1}{2}$ d. per ton, which represents the stated cost, 16s. 11d. less the cost of sorting, say, 2 $\frac{1}{2}$ d. per ton. Thus we get a total cost of £449,115. Comparing these figures with those previously obtained as the cost per ton raised, with sorting, we see that there is a greater profit in the case of sorting of £17,971, or 8d. per ton.

We have assumed up to the present that the waste value was *nil*; we may now see what its actual value may be without loss. Dividing the £17,971 mentioned above by the 26,310 tons rejected as waste, we find that the extraction from the waste must be 13s. 8d. in order to justify us in putting it through the mill. As the extraction will probably not exceed 80%, the original value of the waste must be 17s. 1d. or, say, roughly 4 dwt., before it will pay as well to mill it as to reject it. If the value is greater than this it will pay us to mill it, though the value may be less than the milling cost, because we shall then save the whole cost of the sorting station.

F. H. WRIGHT.

Swansea, November 2.

[When discussing the relative advantages of the ton mined and the ton milled, it is necessary to remember that the metallurgist's results are on the basis of the ton milled. All the ore milled has been mined, but not all the ore mined is milled. So the ore milled has the claim to the basis of comparison. The question of the cost of rejecting or milling waste, and the limiting conditions between the two policies, has often been discussed in our columns and elsewhere. We may refer our correspondent to the *Text-book of Rand Metallurgical Practice*.—EDITOR.]

Short Tube-Mills.

The Editor:

Sir—In addition to the recent article in the Magazine relative to short tube-mills, a number of articles have also appeared in other technical journals bearing upon this same subject. In view of the fact that I perhaps have more interest in the question than your other contributors, an assertion without figures on my part would be of about equal value to the metallurgical fraternity. I would, therefore, like to put the question to any of your practical millmen readers, who have had experience with tube-mills, whether or not they would risk the time to experiment with a cylindrical mill of 8-ft. diameter and 3-ft. length—the average length of the cylindrical portion of the Hardinge mill minus the cones. Just what the critical length of a short tube-mill should be is still subject to investigation, but whatever it may be, that length can be improved by the addition of the conical end, which in itself produces ideal step-reduction, for it certainly prevents the issuing of an undesirable over-size, which issues unground from long as well as short tube-mills.

One mill superintendent who has had a 16-ft., as also a 20-ft., tube-mill working in conjunction with a Hardinge mill for over two years in the same plant and on the same ore, writes that "the Hardinge mill does not follow theory." He goes on to give a long series of figures proving that the Hardinge mill, even as short as 22 inches, does far better work than his tube-mill. That it does not follow theory I also admit, nor am I able to state which of the nine or ten theories explaining the action of the Hardinge mill, or which combination of these, is correct, for I have never claimed scientific wisdom sufficient to cope with the question.

Permit me to reply to Mr. A. E. Drucker's letter in your issue of August 1914, bearing upon Mr. Farrant's remarks upon the subject, and in his absence at the Front. This letter will also reply to Mr. Julius I. Wile's communication.

Taking up the points regarding which these gentlemen raise questions in order, I state the following facts: Referring to the 7 by 12-ft. tube-mill installed at the Morning plant of the Federal Mining & Smelting Co., information is requested as to the data both before and after conversion to a conical mill by inserting a cone in each end. The screen analyses, horse-power, and tonnages, both before and after conversion, as given me by the management are shown in Table I.

You will note that this machine after conversion took a considerably coarser feed, and gave a product containing less slime (the object sought) and therefore more suitable for concentration. From the figures given, based on tons per horse-power, the machine did 23·7% more work after than before the conversion, irrespective of the much coarser feed.

TABLE I. WORK DONE BY 7 BY 12-FT. CYLINDRICAL TUBE-MILL BEFORE AND AFTER CONVERSION TO CONICAL MILL.

| BEFORE CONVERSION. | | | AFTER CONVERSION. | | |
|------------------------|---------|--|------------------------|---------|-------|
| Tons per 24 hours..... | 98'64 | | Tons per 24 hours..... | 88'2 | |
| R.p.m..... | 22½ | | R.p.m..... | 22½ | |
| Water..... | 58'90% | | Water..... | 57'7% | |
| Horse-power | 90 | | Horse-power..... | 65 | |
| Tons per h.p..... | 1'097 | | Tons per h.p..... | 1'357 | |
| Feed | Product | | Feed | Product | |
| On..... 10 mesh 29'5 | | | On..... 8 mesh 19'10 | | |
| 20 " 45'5 | | | 10 " 22'05 | | |
| 30 " 12'0 | 0'5 | | 14 " 17'05 | | |
| 40 " 6'0 | 0'5 | | 20 " 14'50 | 0'10 | |
| 60 " 4'0 | 2'5 | | 28 " 11'80 | 0'45 | |
| 80 " 1'5 | 5'0 | | 35 " 7'05 | 2'25 | |
| 100 " 1'5 | 8'0 | | 48 " 4'20 | 4'50 | |
| 150 " " | 5'5 | | 65 " 1'95 | 7'65 | |
| 200 " " | 20'5 | | 100 " 1'05 | 10'50 | |
| Through 200 " " | 57'5 | | 150 " 0'60 | 17'20 | |
| | | | 200 " 0'20 | 16'0 | |
| | | | Through 200 " " | 0'35 | 41'20 |

TABLE II.

| | Hardinge | Chalmers & Williams |
|-----------------------------------|----------|---------------------|
| Capacity | 115 | 101 |
| Horse-power..... | 36 | 40 |
| Slime—200 mesh (undesirable) | 25% | 34% |
| Tons per horse-power | 3'2 | 2'53 |
| Horse-power per ton..... | 0'313 | 0'396 |

TABLE III.

| Mining Company | Length of mill in feet | Capacity in tons per h.p. |
|----------------------------------|------------------------|---------------------------|
| Arizona Copper..... | 8 | 5'46 |
| Miami Copper..... | 8 | 4'87 |
| Britannia Mining & Smelting..... | 6 | 6'28 |
| Bunker Hill & Sullivan..... | 6 | 5'19 |

It is also stated that an interesting discussion on the relative merits of a short tube-mill and a conical mill has recently been concluded in the American technical press between an 8-ft. by 22-in. cylinder Hardinge mill at the Morning mill of the Federal and a 5 by 14-ft. tube-mill at the Gold Hunter property in the same district, it being further stated that it was demonstrated that this special discharge type of tube-mill would give a granular product to any degree of fineness suitable for concentration. Mr. Wile further gives figures claiming to show that the tube-mill is more efficient than is the Hardinge. In this connection, I would ask: Why is the Hardinge mill credited by Mr. Wile with 48 h.p. for this 22 in. mill? It was, according to the Federal management, actually consuming 36 h.p. net. I would be pleased indeed to have a just com-

parison drawn between the tube-mill at Gold Hunter and results obtained from the Hardinge mill at the Federal plant operating on jig-middling. Taking Mr. Wile's own figures and the actual figures as furnished by the Federal management, instead of being unfavourable to the Hardinge mill they show as in Table II.

I affirm that the ores these two machines are working upon are different, and no comparison would, therefore, be correct, the only similarity being that the two mines are in the same district.

To show capacities of Hardinge mills upon various ores at a few well known mines, I call your attention to the figures in Table III.

The Hardinge mill is the shortest tube-mill made, having a cylinder the average length of which is about one half that of its diameter; the conical end, however, is necessary to reduce the amount of over-size, which would otherwise be considerable.

H. W. HARDINGE.

New York, October 23.

[This discussion is now closed.—EDITOR.]

R.S.M.—A general meeting of the Royal School of Mines Union was held on October 28, when the following officers were elected to carry on the business of the Union during the absence of over half of the students now on active service: President, R. L. Carr; Honorary Treasurer, Professor S. J. Truscott, A.R.S.M.; Honorary Secretary, H. L. Wallis; Honorary Sports and Excursion Secretary, A. C. Hoare, A.R.S.M.; and a committee, G. E. B. Whillock, E. A. Fishwick, H. L. Bernstein, and J. L. Armstrong. At the same meeting Professor H. C. H. Carpenter was elected Honorary President.

PRECIS OF TECHNOLOGY

Iron Ores of French Lorraine.—A paper on the iron ores of eastern and western France was prepared by Paul Nicou for the August meeting of the Iron & Steel Institute. By far the most important iron-ore district of France is in Lorraine, in the department of Meurthe-et-Moselle, centreing round the towns of Longwy, Briey, La Crusnes, and Nancy, and



MAP SHOWING THE LORRAINE IRON-ORE DISTRICT.

we quote the part of Mr. Nicou's paper describing it. The deposits belong to the same group as those in Belgium, Luxembourg, German Lorraine, and Westphalia. This group accounts for 28% of the world's production of iron ore, as compared with 30% for the Lake Superior region. The ore is usually called 'minette,' and contains the hydrated oxide of iron of oolitic structure with varying quantities of silica and carbonate of lime. The percentage of phosphorus is fairly regular at less than 2%, but this content causes no trouble in smelting by the basic or Gilchrist-Thomas process. The development of the Briey deposits has been a notable event during recent years, and has caused the French Lorraine output to become of in-

creasing importance relatively to the output of the neighbouring states. The output has risen from 7,395,000 tons in 1905 to 19,928,000 tons in 1913. During the same period the output in Luxembourg did not increase, being 6,596,000 tons in 1905 and 6,553,900 tons in 1913, and the output of German Lorraine rose from 11,968,000 tons to 21,136,000 tons. Until the Briey deposits were developed, France imported calcareous minette from Luxembourg and German Lorraine to supplement the supplies from Longwy and Nancy. Nowadays the position is reversed, and ore was being sent, before the war commenced, to Luxembourg and Germany, and also to Belgium, whose iron ores are mostly exhausted. It is notable that the ore deposits in German Lorraine constituted the material riches desired in the annexation in 1871, and that deposits of French Lorraine are now partly in the hands of the German foe, to remain in his possession if the Kaiser gets his way.

The French Lorraine deposits may be divided into two sections, separated by a barren zone. One includes the Longwy, La Crusnes, and Briey districts, and the other the Nancy district. Similar deposits have been found farther west near Verdun and Etain, but are of no commercial value. The deposits do not outcrop, and have been prospected by borings. They form part of the great Parisian basin and occur at the contact of the Upper Lias and the Inferior Oolite. The beds are in three groups, one below the other, varying in quality with the locality. Few beds have a greater thickness than 6 ft., but the great grey seam is in places 20 ft. thick. The total thickness of the formation in which the beds are found is about 100 ft. The iron mineral is mixed with varying quantities of sand, marl, and chalk, and in certain parts pyrite is found. The beds have a wide range of colour, brown, black, yellow, grey, and green. The great grey seam is the chief one worked. They are practically horizontal, and are found at distances from 200 to 1500 ft. deep. Shaft-sinking is troublesome owing to water in the overlying strata. The mines at Briey are worked largely by Italian labour that had to be imported because the local population was already fully employed. The pits are on a large scale, none having a less output than 1,000,000 tons per year, and several produce from 2,000,000 to 3,000,000 tons. The initial outlay on the larger pits is from £400,000 to £600,000. It is difficult to give an average analysis of the ore. Probably 30 to 40% iron, and 5 to 15% of lime or silica would give a correct impression. The ore is hard and is smelted without roasting.

Cyanides from Gas-Works.—In recent issues we have written about the supplies of cyanide and its sources and methods of manufacture. Before the Castner process, using the reaction of ammonia on metallic sodium, was introduced, the cyanide used in gold and silver extraction was obtained as a by-product in gas-works. A great many other cyanogen compounds such as the prussiates, prussian blue, and sulphocyanide were and still are produced from this source. In America cyanogen compounds have not heretofore been recovered from coal gas, and the erection of the first recovery plant has only just been recorded. Chemical engineers are now studying the subject, and one of them, C. C. Tutwiler, of Philadelphia, has published a lengthy review entitled 'The Recovery of Gas-Works By-products,' in the *Journal of the Franklin Institute* for October. This paper contains a convenient review of the recovery of cyanides, and being of timely interest, we quote this part of it.

Cyanogen occurs in coal-gas as free cyanogen (CN)₂ and as hydrocyanic acid (HCN), and it is formed by

the reaction of a small proportion of the nitrogen of the coal with the carbon. (It should be remarked that most of the nitrogen of the coal comes off as ammonia). The amount produced depends on the temperature of distillation, the higher the heat the greater proportion being formed. The temperature of 1735° F. is considered the most favourable for its formation. At this temperature the yield measured in hydrocyanic acid will be from 2 to 3 oz. per 1000 cu. ft. of gas. As a rule the temperature employed is less than this, and it is seldom that as much as 2 oz. is obtained. About 10 to 15 per cent. is caught in the ammonia scrubbers, and the remainder reacts on the oxide of iron used in removing the sulphur, with the formation of prussian blue. The latter is treated for the production of the prussiates, otherwise the ferro and ferricyanides of sodium or potassium, from which cyanide can be manufactured. Several processes have been attempted for extracting the cyanogen directly from the gas. The first was introduced by Knublauch, who passed the gas, after the ammonia had been extracted, through a scrubber, where it was brought into contact with a solution containing an alkali and a salt of iron. In this way a solution of ferro-cyanide was obtained, but the process was not extensively used. Afterward the Feld system was tried, by which the gas was treated with a solution of lime and ferrous sulphate for the production of calcium ferro-cyanide. Stavorinus employed a solution of potassium carbonate and iron carbonate made from ferrous sulphate in suspension, and the gas was passed through it before the removal of ammonia. The British Cyanides Company employs a process whereby the gas still containing the ammonia is passed through a scrubber, and granular sulphur dropped intermittently into the ammoniacal liquor. The cyanogen is recovered as ammonium sulphocyanide. The Bueb process also treats the gas with the ammonia in it, bringing it into contact with a solution of ferrous sulphate.

Kirkland Lake and Swastika.—In a report to the Ontario Bureau of Mines, A. G. Burrows and Percy E. Hopkins describe the geology of the Kirkland Lake and Swastika gold region. We extract in the following paragraphs their remarks on the origin and age of the gold deposits.

All the gold deposits of northern Ontario are in the pre-Cambrian rocks which, with few exceptions, are older than the Cobalt series. After the folding of the Timiskaming series and before the deposition of the Cobalt series, there was a period of igneous activity during which basic and acid rocks, including lamprophyre, porphyry, syenite, and granite, were intruded into the older rocks. The lamprophyre is distinctly older than the other intrusives, and has no bearing on the ore-deposition. There are a number of gold-bearing veins at Kirkland lake, along the contact of intrusive felspar-porphyry and older rocks, suggestive of a relationship between the intrusive and the veins. There are areas of granite and syenite within a short distance of the gold deposits. An examination of a number of specimens from these plutonic areas shows that these rocks contain albite, usually as phenocrysts, similar to the felspar-porphyry. It is quite likely that the granite, syenite, and felspar-porphyry belong to the same period of intrusion and are different facies of a plutonic rock that underlies the whole area. The syenite and granite have been exposed by deep erosion. Though the gold-bearing veins were formed subsequently to the intrusion of the porphyry, it is likely that they are genetically connected with the intrusive rock which occurs as dikes and boss-like masses. The cooling of the intrusive was apparently accompanied

by shrinkage, faulting, and displacement in the porphyry itself and in the adjacent rocks. The gold-bearing silicious solutions that deposited their burdens in the fissures and other fractures in all probability represented the end product of the intrusion of the acid rocks.

Waldemar Lindgren in his classification of mineral deposits given in his book 'Mineral Deposits,' places the gold-quartz veins of Ontario in the division of "veins and replacement deposits formed at high-temperature and pressure and in genetic connection with intrusive rocks." He says: "These veins are clearly related to those of the southern Appalachian states, but, on the other hand, they present some remarkable analogies with those of California." The veins of Kirkland lake, which are not quite similar to those in other parts of the province, had not been discovered at the time of the publication of Lindgren's description. These veins were formed at considerable depth and have been exposed by extensive erosion, but it is probable that they were not formed at as high temperatures as the veins at Porcupine, in which tourmaline and pyrrhotite frequently occur. The minerals tourmaline, pyroxene, garnet, amphibole, and biotite, characteristic of deposits formed at high temperatures, have not been recognized by the authors in the Kirkland lake area. Albite, chlorite, sericite, and carbonates are present in the deposits as alteration products. The veins at Kirkland lake greatly resemble in their mineral constituents those of the Sierra Nevada, California, which are described by Lindgren. In these latter veins tellurides like altaite, hessite, calaverite, petzite, and melonite are frequently associated with native gold. In a comparison of the Cripple Creek and Kalgoorlie gold deposits, Lindgren has shown that telluride of gold may be deposited in large quantities both near the surface, as at Cripple Creek, and at a depth of many thousands of feet below it, as at Kalgoorlie. His paper discussing this subject appeared in *Economic Geology* during 1906. Telluride of gold is not so abundant in the Kirkland lake deposits as telluride of lead, but probably occurs in greater quantity than has been suspected, owing to the difficulty of identifying the telluride in fine grains when accompanied by native gold. As stated above, the mineral associations at Kirkland lake are not typically those of high temperature deposits. Magnetite has been found in gold-bearing veins at the Huronian mine, a few miles east of Kirkland lake, and specular iron has been reported in veins from the Tough-Oakes mine. The Kirkland lake deposits have probably been formed at considerable depth, like the Kalgoorlie deposits, but not at such high temperatures, while the mineral association is somewhat similar in that native gold accompanies the tellurides.

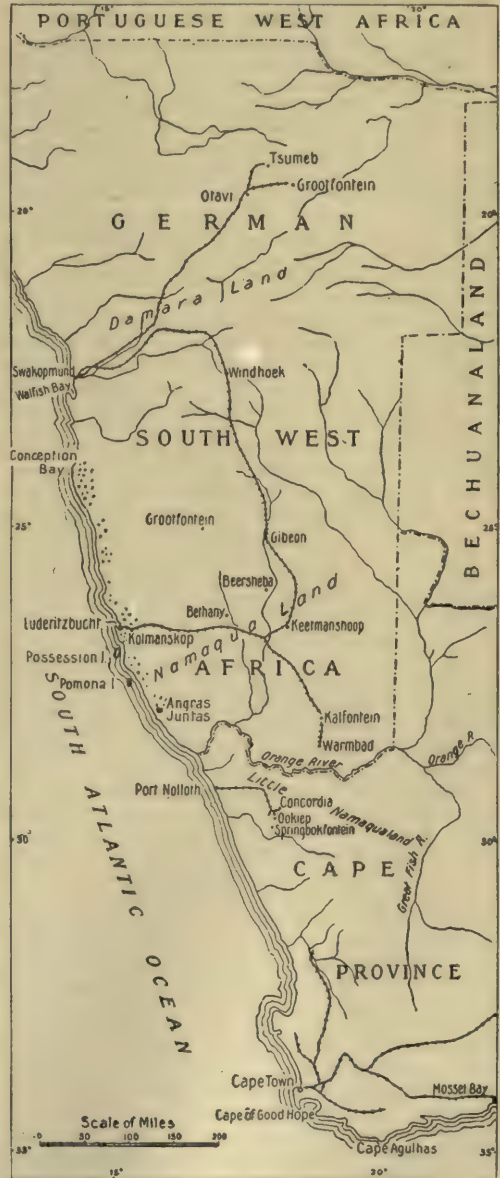
The physical characters of the veins at Swastika and Kirkland lake are different. At Swastika the veins are generally several feet in width and are composed chiefly of white quartz with a few fracture planes, whereas at Kirkland lake the veins are narrow, often extremely brecciated and impregnated with secondary material, the quartz sometimes forming only a small portion of the orebody. The productive veins at Swastika are in the altered Keewatin greenstone, and no veins of economic importance have been found in the conglomerate, although the rock is intruded by the felspar-porphyry. There is no apparent reason why the conglomerate at Swastika should not carry gold-bearing veins as at Kirkland lake. The same may be said of the felspar-porphyry at Swastika, which has not been proved to contain economic gold-bearing veins, though this rock at Kirkland lake shows

some promising veins. The veins at Swastika in their general character, width of quartz, lenticular form, and other features, resemble the veins of the Porcupine area. Tellurides have not been reported in the veins at Swastika, but molybdenite, which is of such frequent occurrence in the Kirkland lake area, has been found in several veins at the Lucky Cross mine.

Diamonds in German South-West Africa.—The war has drawn attention to the mineral deposits of Damaraland and Namaqualand, which have constituted a German colony since 1885. In those days the barren wastes of the territory presented no attractions to the English and Dutch in South Africa, though no doubt possession would have been acquired had the strategical use to which it is now being put been appreciated. As we mentioned in October, the copper-lead deposits at Tsumeb and the diamonds at Lüderitzbucht have proved of importance to German owners. It is of timely interest to quote the description of the diamond deposits appearing in P. A. Wagner's 'Diamond Fields of Southern Africa,' a book reviewed by us in the issue of April last. Though the railway inland from Lüderitzbucht had been constructed across the diamond tract, and the diamonds were lying on the surface of the sandy waste, their presence was not detected until 1908, when a Cape native, formerly employed at De Beers, and at the time at work on the railway at Kolmanskop, recognized them. He communicated his discovery to a railway official named Stauch, who made further investigations and eventually staked large areas of country. A few months afterward, Dr. Range, the Government geologist, issued a report on the discovery, and a rush began. Diamonds were found in the deserts to the north and south of Lüderitzbucht, and prospecting was continued to the north to Walfish bay and to the south to the mouth of the Orange river. The diamonds were also traced in deep water at Possession Island and between the coast and Pomona island, and some dredging was done though with what results is not known. The deposits extend intermittently between latitudes 24° and 28°, a distance of 270 miles, and are at no place farther than 12 miles from the sea.

The diamonds occur in the surface layers, from a few inches to a few feet thick, of the sand of the rainless desert, on the flats and in the dry valleys. The sand, which is fine and yellow in colour, contains from 20 to 40% of coarser material consisting of milky quartz, white felspar, chalcedony, jasper, agate, garnet, epidote, and magnetite, and fragments of granite and gneiss. A violent wind from the south, blowing throughout the summer months, has been the agent in concentrating the diamonds in the superficial layers, the lighter and finer sand having been blown away. The geological structure of the country consists of ancient gneisses and crystalline schists intruded by granite, and ancient limestones, quartzites, and phyllites; over these are the remains of sandstones, grits, marls, and clays of Cretaceous and Tertiary ages. The strike of both ancient and more recent rocks is approximately north and south. The origin of the diamonds is still a debatable point. Some authorities held that they were derived from the ancient rocks, being released by weathering, but this theory has been abandoned, as any detritus known to come definitely from the ancient rocks contains no diamonds at all. Others say that they have been brought down by the Orange river from the British African deposits, or by other rivers, now dry, from the interior of German South-West Africa. It is not likely that they came from the British African deposits, for their physical characteristics are entirely different, and as to the

latter supposition, they are not found in any of these dry river beds, but only near the coast. The most plausible theory is that they have come from a source submerged off the present coast, and as the largest are found in the Pomona district, the source is judged to have been in the vicinity. The diamonds are invari-



GERMAN SOUTH-WEST AFRICA.

ably small, but on the other hand the proportion of those of good quality is unusually high. Fully one half are clear white, and 85% of the output is suitable for cutting. Hardly any black diamond or bort is found. The largest stone hitherto found weighed 34 carats, and the average weight is $\frac{1}{4}$ carat. Owing to the shallowness of the surface layers of sand containing the diamonds, the prospects of a large future output

are not bright, and already the richer parts have been worked. There are, however, extensive tracts of low-grade sands that should yield a profit for some years. The content per cubic metre varies widely, from 60 carats at some patches of ground near Pomona downward. At the Kolmanskop property the average yield was 0.38 carat.

Explosions in Coal Mines.—The Committee on Explosions in Mines appointed three years ago by the British Government has issued its final report giving recommendations for the prevention of explosions due to coal-dust. In previous reports the Committee described the experimental stations at Eskmeals and Altofts, where charges of blasting-powder were fired from cannon in specially constructed galleries, these galleries being strewn with coal dust on the floor and on shelves. The shock of the discharge would raise the dust in clouds, and its heat would cause ignition. The first series of tests showed that if the coal dust was intimately mixed with an equal weight of stone dust, no ignition would take place. Having got thus far, the Committee proceeded to ascertain the influence of methane and coal-gas in helping this half-and-half mixture to ignite, and also to find the relative effects of watering and stone-dusting. The results are published in the report now issued. The Committee found that any proportion of coal-gas present up to 2.3% was not sufficient to assist the ignition of the half-and-half mixture, and that as much as 4.6% of methane, that is, fire-damp, had no influence. In the experiments on watering, the amount of mixture used was the same as in the other experiments, namely 1 oz. per cubic foot of air, or, in a gallery 7½ ft. in diameter, 1 lb. per linear foot for 150 ft. It was found that when clay-shale was used as the source of stone dust, wetted mixtures would not ignite if they contained 23% ash and 20% moisture, 33% ash and 15% moisture, or 39% ash and 9% moisture. These results show that the larger the quantity of incombustible dust mixed with the coal dust the less is the quantity of water required to render the mixture incapable of propagating flame. In round figures it may be said that a coal dust containing up to 15% ash should contain from 25 to 30% of water to prevent the propagation of flame, and that every additional 10% of ash reduces the water required by about 5%. Putting it in another way, if the mixture contains an appreciable quantity of water, say 15% or more by weight, the water is at least as beneficial as an equal weight of incombustible dust. For several reasons the Committee considers that the combination of stone and water is to be preferred to either alone, and that the best mixture should have 40% of ash with 15% of moisture added to it. Owing to the difficulty of bringing the water into intimate mixture with the coal, it is desirable that in practice 30% of water should be used. As regards the best way of wetting the dust, it is shown that rose sprays are of small efficiency, and that a travelling atomizer is necessary. The stone dust employed must be finely divided to be effective, and at least 50% must pass a 200-mesh screen. Some coal-mining engineers stated a few years ago that stone-dusting at intervals would prove efficacious in checking the travel of the flame of the explosion. The Committee however does not adopt this view, but urges that the whole of the workings should be treated. The Committee has also devoted much attention to the character of the stone dust employed. The first experiments were made with fuller's earth, and its imitations or substitutes, but these were not so easily damped as other stones such as clay-shale, dolomite, and oolite. It is obvious that any stone consisting of sharp crystals of silica could not be con-

sidered, owing to their well known harmful action on the lungs. Some of the clay-shales contains a large proportion of silica, but that mined at Altofts is said to be harmless as the silica particles are coated with colloidal silica. That shale dust is not harmful is indicated by the fact that thousands of men have continuously worked in atmospheres containing it, without any complaint ever being made. It is desirable, however, that further information as to the effects of shale and other stone dust should be sought, in order that prejudice against stone-dusting may be removed. Dr. J. S. Haldane has undertaken a series of researches on the physiological effects of dust, at the request of the Committee. The final section of the subject mentioned in the report relates to the proposition to prevent explosions by reducing the oxygen content of the air passed through the mine. This proposition provided for the discharge of some part of the products of combustion from the steam-boilers into the air current. The Committee found that even if the oxygen content were reduced to 17%, the presence of 5 to 10% of methane would still induce an explosion of the mixed dust, and in any case it is quite contrary to public policy to ask men to work in such an atmosphere.

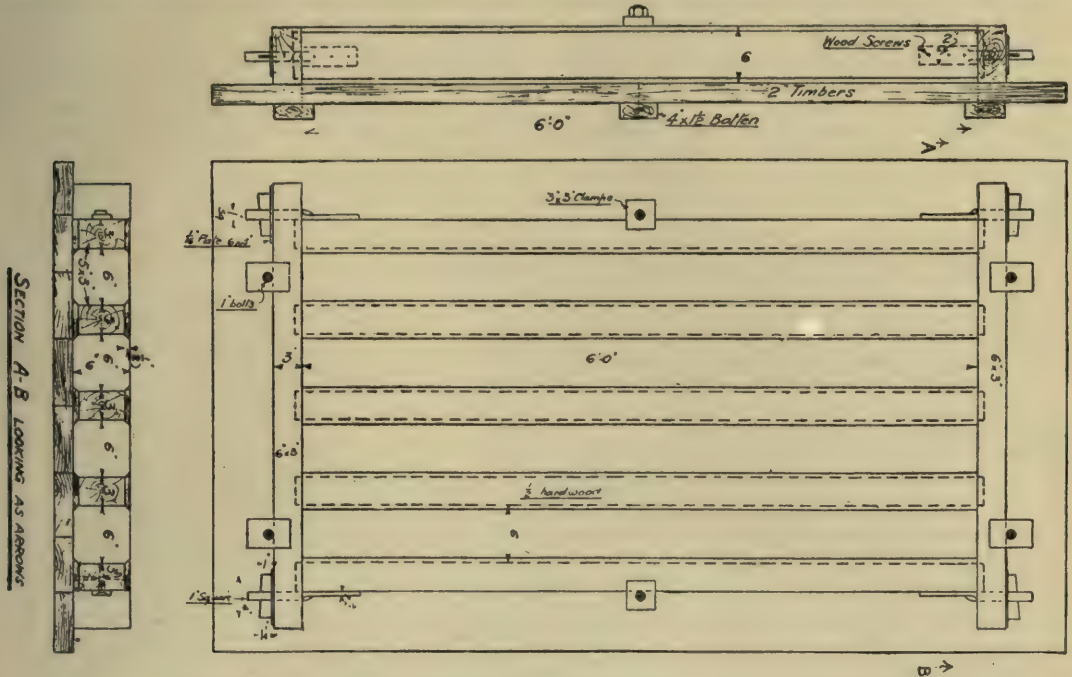
Reinforced-Concrete Mine-Supports.—Owing to the scarcity of timber suitable for use in British coal mines, following the closing of the Baltic Sea, attention is being turned to reinforced concrete as a substitute. We have on previous occasions referred to the use of concrete structures in mines, but as the subject is of timely interest we reproduce herewith some instructions relating to the use of concrete and to the manufacture of beams and props that appear in a pamphlet issued last month by the Associated Portland Cement Manufacturers Limited, of London.

For the manufacture of mine props and beams, slow-setting portland cement, sand, and a coarse material such as gravel or crushed hard stone are required. The coarse material should measure from ¼ to ¾ in. It is necessary that both the sand and coarse material should be washed to free them from clay or loam. The best proportion is 1 cubic foot of portland cement to 1½ cu. ft. of sand, and 3 cu. ft. of coarse material, and it is necessary that the measurements should be carefully made so as to ensure uniformity of the mixture. The concrete should be mixed as near to the moulds as possible, so as to let it have no chance of setting. If it has begun to set, it must not be broken up and used again, though of course if set hard it can be used as coarse material. Mixing should be done on a clean wooden bench or stage, which may be covered with a thin piece of sheet iron or zinc if much mixing is to be done. The measured sand should first be spread in a layer of even thickness; then the portland cement should be distributed over the surface of the sand, and the two layers turned over dry with the shovel until they are thoroughly mixed. The coarse material should then be thrown over the mixture, and the whole turned three times dry, and afterward three times, at least, wet. It is best to add the water a little at a time until the right consistency is obtained than to pour it on all at once. The water should be applied by a water-can with a rose head. The amount of water to be added should be enough to make a slightly 'sloppy' mixture, which when lightly tamped will properly fill every corner of the mould.

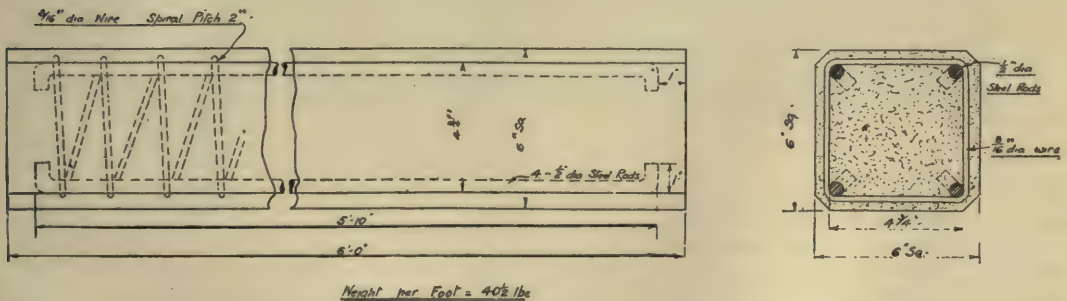
In the illustrations is shown a 6-ft. prop or beam, and a timber mould in which several can be cast at a time. The prop contains four longitudinal rods of mild steel, bound spirally with steel wire. The spirals can be bought from the wire manufacturers ready made. The rods are held to the corners of the spirals

by means of light ties. The prop shown is one of the largest sizes. The following specifications describe four standard sizes: (1) 3 ft. 3 in. by 3 in., $3\frac{1}{2}$ lb. of $\frac{1}{8}$ in. mild steel rod, spiral reinforcement 1 lb. of 12-gauge steel wire, $\frac{1}{8}$ cu. ft. concrete, labour $\frac{1}{2}$ hour; (2) 4 ft. 4 in. by 4 in., $4\frac{1}{2}$ lb. of $\frac{1}{8}$ in. rod, spiral $3\frac{1}{2}$ lb. of 12-gauge steel wire, $\frac{1}{2}$ cu. ft. concrete, labour 1 hour;

and between the reinforcement. To avoid sharp edges, triangular strips are placed in the bottom of the mould, and the top edges are bevelled by a trowel or otherwise. The props should be left in the moulds until they are set, and quite two days should elapse before the sides of the mould are removed. They should then be left on the base board until strong enough to bear



WOODEN MOULDS FOR CASTING REINFORCED CONCRETE MINE-SUPPORTS.



SECTIONS OF CONCRETE SUPPORT 6 FEET LONG.

(3) 5 ft. 5 in. by 5 in., $7\frac{1}{2}$ lb. of $\frac{3}{8}$ in. rod, spiral $6\frac{1}{2}$ lb. of 8-gauge steel wire, $\frac{1}{2}$ cu. ft. concrete, labour $1\frac{1}{2}$ hours; (4) 6 ft. 6 in. by 6 in., $16\frac{1}{2}$ lb. of $\frac{1}{2}$ in. rod, spiral 13 lb. of $\frac{3}{8}$ -gauge steel wire, $1\frac{1}{2}$ cu. ft. concrete, labour 2 hours. In making the props, about $1\frac{1}{2}$ in. of concrete is spread evenly on the bottom of the mould and carefully tamped. The reinforcing framework is placed on this and pressed down to within $\frac{3}{8}$ in. of the bottom, care being exercised that it shall occupy a central position. Concrete is then filled in, and should be carefully tamped by poking it with a small bar or paddle-shaped piece of timber, so as to make it quite dense and to get it into every corner and interstice of the mould

their own weight. Afterward they should be stacked in a protected position sheltered from sun and wind, and wetted daily for 14 days. They can be safely used in about two months, but continue to increase in strength for a year or so. It is possible to mature them more rapidly, in four or five weeks, by stacking them in a chamber the atmosphere of which is kept warm and moist by means of a jet of steam. The moulds are slightly greased or brushed with soft soap to prevent the concrete sticking. Care must be taken not to allow any of it mixing with the concrete, or coming in contact with the rods and wire, otherwise the metal will not bind with the concrete.

CURRENT LITERATURE

Stope-Filling.—At the October meeting of the North of England Institute of Mining and Mechanical Engineers, B. C. Gullachsen read a paper outlining the practice of stope-filling adopted on the Rand.

Australian Tin.—The *Bulletin* of the Imperial Institute for September contains a review of the tin resources of Australia.

Steam Stamps.—In the *Mining and Scientific Press* for October 3, Algernon Del Mar describes various forms of steam stamp and their performance at the Michigan copper mines.

Hall's Sulphur Process.—The *Mining and Scientific Press* for October 3 contains an article by H. F. Wierum detailing his experience with the Hall process for recovering sulphur in elemental form from roaster and smelter gases. We described this process in our issues of August 1913 and February 1914.

Tin-Dredge in Portugal.—In the *Mining and Scientific Press* for October 3, H. G. Peake describes a dredge built by Fraser & Chalmers for a tin-gravel property near Belmonte, Portugal, developed by American owners.

Tin-Mining in Malaya.—The *Mining and Scientific Press* for September 26 contains an article by E. J. Vallentine on recent developments in tin-mining operations in the Federated Malay States.

Zinc Smelting in the United States.—The *Mining and Scientific Press* for September 26 contains a description by E. H. Leslie of the Nassau zinc smelter at Depue, Illinois.

New Furnaces at Mount Morgan.—The *Engineering and Mining Journal* for September 26 contains working drawings of the three new blast-furnaces erected by the Mount Morgan Gold Mining Co., Queensland, for smelting the copper-gold ore by the pyritic process.

Steel Mine-Supports.—The *Colliery Guardian* for October 16 contains an article describing the use of steel arching for supporting the roof in main haulage-way.

Spirlet Roasting Furnace.—The *Engineering and Mining Journal* for October 3 describes the Spirlet roasting furnace, made at Cologne, and designed for the roasting of zinc ore.

Hammer-Drills.—In the *Engineering and Mining Journal* for September 26, Sven V. Bergh gives the results of tests of various drills used in an iron mine in Lapland.

Continuous Decantation.—In the *Engineering and Mining Journal* for October 17 and 31, Herbert A. Megraw discusses the continuous counter-current system of cyanidation. The references are mostly to the new plant at Porcupine, Ontario.

Calcium Carbide.—*Engineering* for August 28, September 4 and 18, and October 2 and 16 contains a description of the hydro-electric factories for manufacturing calcium carbide in Norway, belonging to the Nitrogen Products & Carbide Company.

North Star, Grass Valley.—The *Mining and Scientific Press* for October 10 contains articles by T. A. Rickard, William Hague, and W. D. Pagan on the history and present developments of the North Star gold mine, Grass Valley, California.

Oliver Filter.—In the *Mining and Scientific Press* for October 10, H. A. Morrison and H. G. Thomson give details of the practice with the Oliver slime-filter used at the cyanide plant of the Globe mine in California.

Mining Methods in the Marquette Iron Mines.—The *Mining and Scientific Press* for October 17 con-

tains a report by H. T. Hulst, G. R. Jackson, and W. A. Siebenthal describing methods of stoping employed in the Marquette Iron Range, Lake Superior.

Ore Deposition.—In the *Mining and Scientific Press* for October 17, A. C. Lawson replies to criticisms. In a review of "Types of Ore Deposits," Mr. Lawson had stated that the theory of the origin of ores through magmatic waters was still on trial. This view was combated by Lindgren, Kemp, and Knopf. Mr. Lawson now discusses their objections to the theory that many of the orebodies may have been formed through the activity of meteoric waters heated and stimulated by intrusion of igneous rocks. He insists that the matter is still one under investigation and should be treated as an open question.

Copies of the original papers and articles mentioned under 'Précis of Technology' and 'Current Literature' can be obtained on application to The Mining Magazine.

NEW BOOKS

Transportation of Debris by Running Water. By Grove Karl Gilbert, assisted by Edward Charles Murphy. Quarto, paper covers, 260 pages, illustrated. Washington: U.S. Geological Survey.

This book is Professional Paper No. 86, published by the United States Geological Survey. Thirty-five years ago Mr. Gilbert first studied the action of streams in shaping the surface of the country, more particularly with the object of ascertaining the influence of the tailing from hydraulic operations carried down by the rivers. The investigations forming the subject of this volume are in connection with the physical action of the heavier particles swept along the channel beds. The experimental work was done at Berkeley, California, in the grounds of the University of California.

The Cleaning of Blast-Furnace Gases. By Frederick H. Wagner. Cloth, octavo, 170 pages, illustrated. New York and London: McGraw-Hill Book Co. Price 8s. 4d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book contains a collection of information from various sources relating to the preparation of blast-furnace gases for heating and power purposes, together with the results of research work undertaken by the author. He describes numerous machines for removing the dust from iron blast-furnaces and for cooling them and removing the water vapour; and also for recovering and briquetting the dust, to be returned to the furnace. Another section of the book deals with the methods of removing sulphurous and sulphuric acids, and dust, from copper and lead furnaces.

Safety and Efficiency in Mine Tunneling. By David W. Brunton and John A. Davis. Octavo, paper covers, 265 pages, illustrated. Washington: Bureau of Mines.

This is Bulletin 57 published by the United States Bureau of Mines. It contains the results of investigations undertaken with a view to assuring greater safety in connection with the methods of driving, supporting the roof, handling of explosives, etc. A section is devoted to the cost of this department of mining operations, and another to the history of tunneling from the earliest days.

Since receiving the Bulletin, we have heard that its contents slightly re-arranged have been published by John Wiley & Sons as a book entitled 'Modern Tunneling,' price 15s. net.

COMPANY REPORTS

Camp Bird.—We have already referred to the troubles accruing to this company from the financial collapse of A. M. Grenfell, the chairman, and we have recorded the subsequent transfer of the control to H. C. Hoover. The report now issued covers the year ended June 30. During this time, the Camp Bird mine, in Colorado, has continued to produce ore at a profit on a small scale. The amount of ore treated was 30,595 tons, from which metal was recovered having a gross value of \$801,079, of which gold represented \$700,879, silver \$72,206, lead \$13,378, and copper \$14,617. These metals are produced as bullion by amalgamation and cyaniding, and in the form of concentrates. The yield per ton was \$26.19, equal to £5. 7s. 7d. The working profit was £70,292 or £2. 6s.

June 30 was calculated at 976,000 tons, from which a profit of £740,000 should be obtained, together with 218,000 tons of probable ore that should yield a profit of £113,000. Operations were suspended on April 21 owing to communication being cut-off. During the period of production, 293,836 tons of ore was treated yielding bullion containing 16,587 oz. gold and 3,182,341 oz. silver. The net profit was £126,627. Under the circumstances following the Grenfell failure, it is impossible to pay a dividend.

Tolima Mining.—This company was formed in 1871 to acquire the Frias silver-lead mine in the state of Tolima, Colombia. In the early days large profits were made, but in 1903 and 1909 it became necessary to raise additional funds for development. Since then small profits have been made and the debenture debt has been redeemed. Arthur J. Russell is managing



THE SANTA GERTRUDIS MINE AND OLD MILL.

per ton. The development during the year has been on a restricted scale. The ore reserve is estimated at 25,709 tons, which should yield a profit of \$307,648. The company owns the majority of shares in the Santa Gertrudis, particulars of which are given in the succeeding paragraph, in the Messina (Transvaal) Development Co., and in the Central American Gold-fields Syndicate formed to acquire the Bonanza and other mines in Nicaragua. As regards the last named, a dispute has arisen as to the title and litigation will probably supervene. A dividend on the 7% preference shares has been paid, absorbing £45,500.

Santa Gertrudis.—This company is a subsidiary of the Camp Bird, mentioned in the preceding paragraph, and owns a silver mine at Pachuca, Mexico. It was formed at the end of 1909, with a capital of £1,500,000, of which £1,113,096 is held by the Camp Bird. As we recorded in our issue of September 1913, the development below the 18th level has proved disappointing. Since then exploratory work has been done laterally, with promising results. The reserve on

director, and John Russell superintendent. The report for the year ended June 30 last shows that 16,150 tons of ore was raised, from which 1298 tons of concentrate was produced, averaging 432 oz. silver per ton and 18% lead. This was exported and realized £60,610. The developments have continued to be favourable, and the reserve on June 30 was estimated to be capable of yielding 2180 tons of concentrate. The deepest working is at 2000 ft., at which point the lode gives every indication of a continuation of productiveness. The profit for the year was £5265, out of which £2333 has been spent on exploration, and £2500 distributed as dividend, being at the rate of 2½ per cent.

Broken Hill Proprietary.—The report for the half-year ended May 30 shows that 147,577 tons of ore was raised, the average metal content of which is not mentioned. At the dressing plant, 139,991 tons of ore was treated for a yield of 24,059 tons of lead concentrate averaging 61.46% lead and 27 oz. silver per ton. At the re-grinding plant 88,124 tons of old tailing and

37,247 tons of current jig-middling was treated, and 3336 tons of concentrate was produced averaging 53.2% lead and 26.9 oz. silver per ton. At the flotation plant, 168,558 tons of tailing of unspecified assay yielded 37,745 tons of zinc concentrate averaging 46.3% zinc, 6.3% lead, and 12.9 oz. silver per ton. A plant with a weekly capacity of 2500 tons is being designed to treat slime by the differential process of flotation. At the smelters, the lead furnaces treated 102,214 tons of oxidized ore, concentrate, slime, and residue from the zinc furnaces, but details are not given as to how much of this material came from the company's own mine and how much was purchased. The total output was 48,404 tons of bullion. At the refinery 48,322 tons of bullion was treated, yielding 40,125 tons of soft lead, 221 tons of antimonial lead, 2,067,182 oz. of silver, and 916 oz. of gold. At the zinc plant 5983 tons of concentrate and slime was roasted and smelted, yielding 2043 tons of spelter and 248 tons of blue powder. The net profit for the half-year was £150,714, out of which £107,050 has been distributed as dividend. No dividend is to be paid for the current half-year's account, because of the war. Diamond-drilling has revealed no new ore, and mining and milling were on a two-thirds basis. The iron and steel works at Newcastle are approaching completion, and it is expected that the blast-furnace will start in January.

Broken Hill South Silver.—The report of this company for the half-year ended June 30 shows that 172,421 tons of ore was raised averaging 15.2% lead, 13.8% zinc, and 6.9 oz. silver per ton. At the dressing plant 28,745 tons of lead concentrate was produced averaging 68.5% lead, 7.1% zinc, and 22 oz. silver. In addition 105,779 tons of zinc tailing was produced averaging 16.7% zinc, 3.2% lead, and 3.2 oz. silver, and 27,367 tons of slime averaging 10.6% lead, 13.1% zinc, and 7 oz. silver. The zinc tailing was sold to the Amalgamated Zinc (De Bavay's) company, together with 1240 tons of dump material of similar quality. The Zinc Corporation took 36,373 tons of old zinc tailing averaging 18.1% zinc, 7.1% lead, and 4.6 oz. silver. Most of the ore raised during the half-year came from the 970, 1070, and 1170-ft. levels. The 1270-ft. level is being opened. The No. 1 shaft has been sunk to 1509 ft., and plats are being cut at 1370 ft. and 1470 ft. The first unit of flotation plant to treat slime, having a capacity of 500 tons weekly, is under construction. The company has on hand 900,000 tons of old tailing averaging 16.3% zinc, 5.6% lead, and 3.5 oz. silver, under contract for sale to the Zinc Corporation, and 378,000 tons of slime averaging 11.1% lead, 14.1% zinc, and 6 oz. silver. The accounts show an income of £314,300 from the sale of lead concentrate and £34,794 from the sale of zinc tailing. The net profit was £141,100, out of which £140,000 was distributed as dividend, being at the rate of 70% for the half-year. On August 5 the mine was closed owing to the suspension of contracts for the delivery of the products. Since then the mine has been reopened and is being worked half-time. W. E. Wainwright is the manager.

Caucasus Copper.—This company was formed in 1900 to acquire extensive deposits of low-grade copper ore at Dzansul in the Russian Caucasus. Large amounts of capital have been subscribed by eminent English and American financial houses such as Pierpont Morgan and Hambro. Unfortunately the debt is still accumulating. The report for the year ended May 31 shows that 3936 metric tons of copper was produced, which being sold in Russia yielded an income of £342,653. The mining and smelting cost was £249,911, London expenses £2085, interest on loans

and debentures £72,129, and allowance for depreciation £49,810. The loss for the year was £28,838. The issued capital is £513,500, and the debentures amount to £1,278,000; in addition to which there are loans and debts to the extent of £245,000. The interest on the second debentures has not been paid, and the holders have consented to postpone its payment for two years, and to suspend the establishment of the sinking fund for a time. The fourth unit of concentration plant was completed in November 1913, bringing the capacity to 1000 tons per day. Owing to the faulty construction of the aerial ropeway, the delivery of ore to the concentrator has not reached this level. A Minerals Separation plant has been erected for the treatment of slime. Steam shovels have been provided for the removal of overburden, as the scanty rainfall has prevented the hydraulic stripping system from being a success. The war is interfering with operations, for large numbers of efficient workmen have been called away.

North Anantapur Gold Mines.—This company was formed in the middle of 1908 by John Taylor & Sons for the purpose of acquiring a gold mine at Anantapur, in Madras Presidency, India. The vendor was the Anantapur Gold Field Limited. The report for the year ended June 30 shows that 25,450 tons of ore was raised and treated, yielding gold worth £46,888. During the previous year 22,827 tons of ore yielded £35,867, and the year before 17,568 tons yielded £24,152. Out of the profit, £3043 was written off for depreciation, £2114 written off preliminary expenditure, and £336 paid to the directors and managers as percentage of profit. The preference shareholders received 25% dividend and the ordinary shareholders 5%, absorbing £6335. The development has disclosed ore north of the No. 5 shaft between the 650 and 750-ft. levels, and the reserve has been increased by 8000 tons to 52,000 tons. The 750-ft. level is being driven southward but has not yet intersected any orebody. Owing to the ore being free-milling, little gold is left in the tailing for extraction by cyanide, and the cyanide annex may be abandoned. A tube-mill is being erected, and by means of the fine grinding obtainable therewith, an efficient extraction will be obtained by amalgamation. About 55,000 tons of tailing remains to be treated by the cyanide plant.

Cornwall Tailings.—This company was formed in 1910 to buy the old tailing heaps belonging to the Carn Brea & Tincroft company, at Camborne. The control is with the Lempriere-Lionel Robinson group, Arthur Richards is managing director, and Ross K. Macartney is manager. The tailing is transported to dressing floors, previously belonging to the Wheal Agar mine, where it is re-ground and concentrated on tables and buddles. The report for the year ended February last shows that 113,116 tons of tailing was treated for a yield of 369 tons of tin concentrate. The cost was 3s. 6d. per ton. The assay-value per ton is given in terms of the dry ton (113,116 tons wet corresponding to 95,540 dry tons) at 15.86 lb. metallic tin as compared with 19.1 lb. the year before. In the meantime the capacity of the plant had been increased and the cost per ton decreased, so that it was possible to work material of lower average grade. The year before 78,885 tons had been treated at a cost of 4s. 6d. The percentage of recovery was 30% actually sold and 5% in middlings to be re-treated, as compared with 33% and 5% the previous year. The percentage was purposely made less because it was found that the cost of extracting the other 3% was another shilling per ton, required for re-grinding. The accounts show an income of £35,659, and the expenses including depreciation of

plant £23,280. Owing to the fall in the price of tin, the stock of concentrate on hand had to be written down severely, the value now being reported at £1000 as compared with a similar stock valued at £7886 the year before. The net profit for the year was £3749. The sum of £12,500 was distributed as dividend, but this was provided almost entirely out of the balance brought forward from the previous year. Experimental work for the improvement of the extraction is suspended at present. The reserve contains 850,000 tons, and it has become necessary to choose the better portions in order to maintain profits.

China Clay Corporation.—This company was formed in 1910 by L. Ehrlich & Co. to acquire and develop a china-clay deposit at Redlake in the southern part of Dartmoor, Devonshire. E. T. McCarthy is a member of the board and John Mutton is manager. The plan is to pump the clay and deliver it through an earthenware pipe-line eight miles long to drying works at Cantrell, near Bittaford station, on the Great Western railway between Plymouth and Exeter. Owing to faulty construction on the part of the contractors, the pipe-line has had to be re-laid. The report for the year ended June 30 shows that the pumping plant was erected at the end of 1913, and that the first drying-kill was completed early in June. Clay was produced during June and July, and deliveries were about to be commenced when the war started. As a large part of the company's customers are on the continent, operations have necessarily been suspended. The construction of a second dryer is, however, being continued, whereby the capacity will be raised to 32,000 tons per year. The question of further expansion is deferred for the present. Owing to the delay caused by the imperfections of the pipe-line, additional working capital was required. This was raised by the issue of £20,000 debentures. The share capital is £269,985, of which £150,000 is in ordinary shares forming part of the purchase price, and the remainder in participating preference shares subscribed in cash.

Nourse Mines.—This company was formed in 1894 as the Nourse Deep to acquire properties on the dip of the Henry Nourse in the central part of the Rand. In 1905 the mine of the parent company was absorbed, as was also the mine of the South Nourse in 1909. The control is with the Rand Mines group. There are two mills, containing 260 stamps and 7 tubes, with an aggregate capacity of 58,000 tons per month. The full capacity has not yet been attained, though steady increase was made since the last addition of plant in 1910, until for the year ended June 30, 1913, the output had risen to 52,500 tons per month. Unfortunately after that date the labour troubles caused a shortage of hands underground, and for the year ended June 30 last the monthly output was only 45,000 tons. Moreover the extraction declined by 1s. 10d. per ton, standing at 28s. 4d., owing to the fact that a greater proportion of Main Reef was stoped, this ore being mined by machine-drill more easily than the other 'reefs.' The working cost was practically the same, at 21s. 2d. per ton. With the smaller output the cost would have increased, but for the improvement in the system of underground haulage, now completed. Owing to the great number of dikes and to widely distributed faulting, an unusual number of slope-faces are required, and stoping is best done by hand-labour. The amount of ore raised during the year was 629,733 tons, and after 14% had been rejected as waste, 539,800 tons averaging 29s. per ton was sent to the stamps. The yield of gold was 129,584 oz. by amalgamation and 52,256 oz. by cyanide, a total of 181,840 oz. worth £764,608. The working cost was

£572,381, leaving a working profit of £192,226 or 7s. 1d. per ton. The net profit was £160,879, out of which £155,216 was distributed as dividend, being at the rate of 18½%. The development work added 1,061,000 tons to the reserve, averaging 6'1 dwt. per ton. This assay-value is lower than in past years, and is caused by the greater proportion of Main Reef included. The reserve on June 30 was calculated at 811,920 tons in the Main Reef averaging 5 dwt., 588,080 tons in the Main Reef Leader averaging 7'1 dwt., and 1,073,700 tons in the South Reef averaging 7'1 dwt. R. A. Barry is the manager, and H. Stuart Martin is the consulting engineer.

Consolidated Main Reef.—This company was formed in 1896 to acquire gold-mining properties in the middle west Rand, owned by the Main Reef and Consolidated Angle-Tharsis, two companies that were formed in 1888 and 1893 respectively. The control is with the Neumann group. Milling was started in 1888 and was subsequently suspended on many occasions. The first dividend was paid in 1907. The report for the year ended June 30 last shows that the strikes in July and January had an adverse effect on mining and development. The average number of natives employed underground was 1442 as compared with 1872 the year before. More machine-drilling had therefore to be employed, the percentage of ore broken by this means being 60 as compared with 45 the year before. The amount of ore raised was 273,530 tons, and after the rejection of 11% waste, 241,257 tons was sent to the stamps. The extraction by amalgamation was 68,014 oz. and by cyanide 22,418 oz., a total of 90,432 oz. worth £379,551 or 31s. 6d. per ton. The working cost was £262,942 or 21s. 10d. per ton, leaving a working profit of £116,609 or 9s. 8d. per ton. The development disclosed 238,480 tons averaging 7'6 dwt. per ton, and the reserve on June 30 was estimated at 693,460 tons averaging 7½ dwt. David Wilkinson, the consulting engineer, describes the details of development and gives the opinion that the outlook as regards ore production is better than it has ever been, and that if the labour supply is satisfactory, the profits should substantially increase. J. E. Healey is the manager.

Main Reef West.—This company is under the same control and management as the Consolidated Main Reef mentioned in the preceding paragraph, the properties being neighbours. The labour troubles had similar effects at this mine, and for the year ended June 30 last, the tonnage was less by 19,000 tons, the yield per ton 1s. 7d. less, the cost 10d. greater, and the working profit £33,881 lower. The amount of ore raised was 240,928 tons, and after the rejection of 11% waste, 212,852 tons averaging 7 dwt. was sent to the mill. The yield by amalgamation was 53,416 oz., and by cyanide 18,818 oz., a total of 72,234 oz., worth £303,110 or 28s. 5d. per ton. The working cost was £246,479 or 23s. 1d. per ton, leaving a working profit of £56,640 or 5s. 4d. per ton. Out of this, £10,611 was spent on capital account in connection with shaft-sinking, £25,000 was allocated to debenture-redemption, and £16,248 was paid as debenture interest. The shareholders received nothing. The company was registered in 1899 and milling commenced in 1909. Dividends were paid in 1910, 1911, 1912, and 1913. The ore reserve was estimated on June 30 at 526,440 tons averaging 5'7 dwt., a fall of 65,390 tons and 0'3 dwt. as compared with the year before. The results of development in the western section have been disappointing and the policy is to develop the lower levels in the hope of finding a better quality of ore. During the current year a further reduction of the working profit is to be expected.

Simmer and Jack Proprietary Mines.—This company was formed in 1887 to acquire property in the eastern part of the Central Rand. The mine has been producing regularly since 1888 and at one time was almost the leading mine on the Rand, though the ore was always of lower grade than that of its neighbours on the west. The control is with the Consolidated Gold Fields of South Africa, C. D. Leslie is superintending engineer, and O. P. Powell is manager. The report for the year ended June 30 shows that the scarcity of native labour and the strikes had an adverse effect on the tonnage raised and the working cost per ton, while the yield per ton fell. The tonnage milled was 142,600 tons less, at 769,600 tons; the working cost per ton 1s. 3d. higher, at 12s. 4d.; and the yield per ton 8d. less, at 20s. 7d. The total yield of gold was 188,602 oz. worth £793,639, and the working cost £475,660, leaving a working profit of £322,678. The shareholders received £337,500, being at the rate of 11½% on the capital £3,000,000. The ore reserve was estimated at 2,320,000 tons averaging 5·4 dwt. as compared with 2,524,000 tons averaging 5 dwt. per ton the year before. In addition 348,000 tons averaging 4·6 dwt. is returned as partly developed ore. Caved areas on the outcrop are being reopened and additional supplies of ore obtained thereby.

Sub-Nigel.—This company was formed by the Consolidated Gold Fields of South Africa in 1895 to acquire property in the Heidelberg district of the Transvaal, containing banket deposits similar to those of the Rand, and assumed to constitute the southern outcrop of the far east Rand basin. The property is on the dip of that of the Nigel company belonging to the City & Suburban group, but it has not enjoyed the same degree of prosperity. An amalgamation was effected in 1909 with Nigel Deep, another of the Consolidated Gold Fields subsidiaries, owning adjacent property on the dip of the Nigel. Nigel Deep had been more successful, and had a metallurgical plant containing 30 stamps and 1 tube-mill. The report of the amalgamated company for the year ended June 30 shows that 82,719 tons was mined, and after the removal of 30% waste, 57,655 tons was sent to the mill. The yield of gold was 25,746 oz. worth £108,038, or 37s. 5d. per ton. The working cost was £89,023 or 30s. 10d. per ton. With additional items of revenue, the working profit was £23,339, out of which £21,579 was distributed as dividends, being at the rate of 5%, as compared with 7½% last year, when the first dividend was paid. The sum of £14,439 was spent out of capital during the year, chiefly on shaft-sinking and development. Development amounting to 5577 ft. was done during the year, of which 3995 ft. was sampled, disclosing banket averaging 11 in. in width assaying 25 dwt. The reserve on June 30 was calculated at 160,000 tons averaging 7·2 dwt. together with 69,000 tons partly developed estimated to average 8·5 dwt. The developments have been satisfactory during the year, so much so that the directors have ordered additional plant to bring the monthly capacity to 8000 tons. C. F. Parry is the manager.

Globe & Phoenix.—This company was formed in 1895 to acquire gold mines, in the Sebakwe district of Rhodesia, 140 miles north of Bulawayo. The Globe did not last long, but the Phoenix has proved to be the star mine of the state. A dike between the 15th and 16th levels disturbed the regularity of the high-grade ore, and since then the developments have given varying results. A year ago it became necessary to use a larger proportion of the reserve of ore of very high grade in order to maintain the output of gold. The report for the half-year ended June 30 shows that

rich ore has once again been found, in the northern parts of the 19th and 20th levels. In the 21st level, which had hitherto been disappointing, ore averaging 14 dwt. over 40 in. has been proved, for a length of 80 ft., so that the prospects on this level are now more encouraging. In consequence of the improved developments, the reserve has increased as compared with March 31, the figures now being 188,000 tons averaging 29·1 dwt., and six months previously 181,300 tons averaging 27·4 dwt. During the half-year under review, 37,517 tons averaging 31·7 dwt. was sent to the mill, where the stamps and grinding-pans extracted 40,878 oz.; 3226 oz. was recovered from 1536 tons of roasted concentrate, 3130 oz. from 13,585 tons of weathered slime, averaging 5·2 dwt., and 3835 oz. from 16,267 tons of roasted sand, making a total yield of 51,069 oz. worth £215,325, or £5. 14s. 9d. per ton. The working cost was £76,167 or £2 per ton, not including depreciation or London expenses, and in addition £24,474 was spent on capital account, largely in connection with shaft-sinking. No accounts are presented with the half-yearly report, but two dividends aggregating 60% or £120,000 have been paid. The new vertical shaft has been sunk to 2016 ft. and connection made with the workings on the 19th level. The ventilation of the mine has been greatly improved thereby, and it is consequently hoped that the government will allow a second shift per 24 hours to be worked, instead of only one of 8 hours as at present. H. A. Piper and A. J. Fraser are the consulting engineers, and Theodore Haddon is manager.

Gaika Gold.—This company was formed in 1902 to acquire the Gaikamine from the Willoughby's Consolidated and the Rhodesian Exploration and Development companies. The mine is close to the Globe and Phoenix. In 1912, the control passed to the Gold Fields Rhodesian Development Co. Milling commenced in 1905, and the first dividend was paid in 1911. The report for the year ended June 30 last shows that development has given gratifying results and that the ore reserve has been increased by 30,000 tons, standing at the date of the report at 100,770 tons averaging 14·6 dwt. per ton. During the year, 36,928 tons of ore was treated yielding 19,489 oz. worth £82,680, or 44s. 8d. per ton. The working cost was £47,869, or 25s. 11d. per ton, but the total cost was £54,080 or 29s. 3d. per ton. The profit was £29,126, out of which £27,349 was distributed as dividend, at the rate of 10%. J. Murdock Eaton is manager.

Swaziland Tin.—This company was formed in 1905 under Transvaal laws to acquire tin-gravel properties at Embabane, in Swaziland. The control is with the Central Mining group, J. Jervis Garrard is consulting engineer, and T. Kelly is manager. The issued capital is £82,000, and dividends have been paid continuously, averaging 12½%. The report for the year ended June 30 shows a drop in the profits owing to the fall in the price of tin, and to the poorer quality of the ground treated, in spite of a notable increase in the capacity of the plant. The amount treated was 722,014 cu. yd. as compared with 408,345 cu. yd. the year before. The yield of black tin per yard was 1·18 lb. as compared with 1·83 lb. the year before, and the revenue per yard 1s. as compared with 2s. 2d. The working cost per yard was 9½d. as compared with 1s., and the working profit per yard 2½d. as compared with 1s. 2d. The total output of tin concentrate was 379 tons and the revenue £39,725. The dividend absorbed £4100, being at the rate of 5%. The proved reserve is 2,056,000 cu. yd. averaging 1·47 lb. metallic tin per yard, and the bore-holes indicate 10,000,000 cu. yd. additional ground to be worked later.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor.

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STATISTICS.

PRODUCTION OF GOLD IN THE TRANSVAAL.

| | Rand | Else-where | Total | Value |
|-------------------|-----------|------------|-----------|------------|
| | Oz. | Oz. | Oz. | £ |
| Year 1912 | 8,753,563 | 370,731 | 9,124,299 | 38,757,560 |
| Year 1913 | 8,430,998 | 363,826 | 8,794,824 | 37,358,040 |
| January 1914..... | 621,902 | 29,851 | 651,753 | 2,768,470 |
| February | 597,545 | 28,716 | 626,261 | 2,660,186 |
| March | 657,708 | 29,093 | 686,801 | 2,917,346 |
| April | 655,607 | 28,270 | 683,877 | 2,904,924 |
| May | 689,259 | 30,970 | 720,229 | 3,059,340 |
| June | 688,232 | 29,694 | 717,926 | 3,049,558 |
| July | 703,136 | 29,349 | 732,485 | 3,111,398 |
| August | 684,607 | 27,311 | 711,918 | 3,024,037 |
| September | 677,063 | 25,107 | 702,170 | 2,982,630 |
| October..... | 703,985 | 29,761 | 733,746 | 3,116,754 |

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

| | Gold mines | Coal mines | Diamond mines | Total |
|-----------------------|------------|------------|---------------|---------|
| June 30, 1913..... | 188,094 | 9,060 | 14,654 | 211,808 |
| July 31..... | 170,242 | 9,403 | 13,378 | 193,023 |
| August 31..... | 158,223 | 9,236 | 13,172 | 180,631 |
| September 30..... | 152,637 | 9,361 | 12,321 | 174,319 |
| October 31..... | 148,882 | 9,377 | 12,712 | 170,971 |
| November 30..... | 147,569 | 9,286 | 12,680 | 169,535 |
| December 31..... | 150,012 | 9,516 | 11,811 | 171,339 |
| January 31, 1914..... | 154,202 | 9,471 | 11,979 | 175,652 |
| February 28..... | 157,673 | 9,508 | 12,266 | 179,447 |
| March 31..... | 162,815 | 9,619 | 13,390 | 185,824 |
| April 30..... | 165,005 | 9,625 | 14,150 | 188,780 |
| May 31..... | 165,433 | 9,619 | 14,284 | 189,336 |
| June 30..... | 166,248 | 9,442 | 13,256 | 188,946 |
| July 31..... | 167,006 | 9,257 | 13,656 | 189,919 |
| August 31..... | 168,851 | 9,485 | — | 178,316 |
| September 30..... | 169,619 | 9,389 | — | 179,008 |
| October 31..... | 170,438 | 9,212 | — | 179,650 |

COST AND PROFIT ON THE RAND.

| | Tons milled | Yield per ton | Cost per ton | Profit per ton | Total profit |
|-------------------|-------------|---------------|--------------|----------------|--------------|
| | | s. d. | s. d. | s. d. | £ |
| Year 1912..... | 25,486,361 | 29 2 | 19 3 | 9 11 | 12,678,095 |
| Year 1913..... | 25,628,432 | 27 9 | 17 11 | 9 6 | 12,189,105 |
| January 1914..... | 1,902,733 | 27 4 | 18 2 | 9 3 | 876,577 |
| February..... | 1,861,442 | 26 10 | 17 11 | 8 10 | 823,654 |
| March..... | 2,094,098 | 26 4 | 17 3 | 9 1 | 945,000 |
| April..... | 2,075,561 | 26 6 | 17 3 | 9 3 | 955,600 |
| May..... | 2,196,287 | 26 3 | 17 0 | 9 3 | 1,011,968 |
| June..... | 2,178,161 | 25 5 | 17 1 | 9 5 | 1,025,629 |
| July..... | 2,281,717 | 25 10 | 16 9 | 9 1 | 1,032,562 |
| August..... | 2,261,800 | 25 5 | 16 8 | 8 9 | 988,567 |
| September..... | 2,188,939 | 25 11 | 16 9 | 9 1 | 989,859 |

The above are the official statistics published by the Transvaal Chamber of Mines. They understate the cost by about 15% and the profit by about 30%.

GOLD OUTPUT OF INDIA.

| Year 1912 | Year 1913 | Oct. 1914 | Year 1914 |
|------------|------------|-----------|------------|
| £2,265,094 | £2,299,315 | £198,191 | £1,930,649 |

PRODUCTION OF GOLD IN WEST AFRICA.

| Year 1911 | Year 1912 | Year 1913 | October 1914 | Year 1914 |
|-----------|-----------|-----------|--------------|-----------|
| £ | £ | £ | £ | £ |
| 1,069,442 | 1,497,179 | 1,634,700 | 159,410 | 1,424,671 |

PRODUCTION OF GOLD IN RHODESIA.

| Year 1911 | Year 1912 | Year 1913 | October 1914 | Year 1914 |
|-----------|-----------|-----------|--------------|-----------|
| £ | £ | £ | £ | £ |
| 2,647,894 | 2,707,368 | 2,903,267 | 337,241 | 2,958,827 |

PRODUCTION OF GOLD IN WESTERN AUSTRALIA.

| | Export oz. | Mint oz. | Total oz. | Total value £ |
|---------------------|------------|-----------|-----------|---------------|
| Total, 1913 | 86,255 | 1,227,888 | 1,314,143 | 5,448,332 |
| January, 1914 | 9,762 | 102,261 | 112,023 | 475,840 |
| February | 8,493 | 94,812 | 103,305 | 438,809 |
| March | 1,173 | 91,446 | 92,619 | 393,418 |
| April | 8,774 | 90,233 | 99,007 | 420,553 |
| May | 7,138 | 99,068 | 106,206 | 451,132 |
| June | 1,725 | 99,290 | 101,015 | 429,081 |
| July | 8,294 | 88,305 | 96,599 | 410,324 |
| August | 101 | 102,346 | 102,447 | 435,164 |
| September | 1,535 | 103,577 | 105,112 | 446,485 |
| October | 2,028 | 99,366 | 101,394 | 430,692 |
| November | 1,217 | 109,282 | 110,499 | 469,387 |

OTHER AUSTRALASIAN GOLD PRODUCTION.

| | 1912 | 1913 | Nov. 1914 | 1914 |
|-------------------------|-----------|-----------|-----------|-----------|
| | £ | £ | £ | £ |
| Victoria | 2,039,400 | 1,847,400 | 118,000 | 1,563,900 |
| Queensland | 1,484,160 | 1,118,610 | 96,450* | 803,110† |
| New South Wales | 702,129 | 635,703 | 53,425* | 425,615* |
| New Zealand exp't | 1,345,115 | 1,345,131 | 12,876† | 822,395† |

*July figures only. †October figures only.
†August figures only.

AMERICAN COPPER PRODUCERS' ASSOCIATION'S FIGURES.
In Tons of 2240 lb.

| | Production. | Domes- tic | Deliveries Foreign | Total | Stocks at end of month |
|--------------------|-------------|---------------|-----------------------|---------|------------------------------|
| Total 1913 | 724,307 | 342,566 | 387,974 | 730,540 | — |
| January 1914 | 58,826 | 21,409 | 39,266 | 60,675 | 38,933 |
| February..... | 54,715 | 21,244 | 37,455 | 58,699 | 34,949 |
| March | 65,023 | 31,184 | 39,983 | 71,167 | 28,805 |
| April | 67,634 | 28,315 | 36,761 | 65,076 | 31,363 |
| May | 63,530 | 24,818 | 32,460 | 57,278 | 37,615 |
| June | 63,101 | 20,637 | 32,745 | 53,382 | 47,334 |

No figures published since

The United States Customs report exports as follows:

July 34,145 tons, August 19,676 tons, September 23,866 tons, October 24,550.

NIGERIAN TIN PRODUCTION.

In tons of concentrate of unspecified content.

| Year 1912 tons | Year 1913 tons | Sept., 1914 tons | Year 1914 tons |
|-------------------|-------------------|---------------------|-------------------|
| 2,532 | 5,032 | 289 | 3948 |

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

Estimated at 70% of concentrate shipped to smelters.

| 1911 tons | 1912 tons | 1913 tons | Sept., 1914 tons | Year 1914 tons |
|--------------|--------------|--------------|---------------------|-------------------|
| 43,967 | 48,250 | 50,128 | 3,908 | 36,983 |

SALE OF TIN CONCENTRATE AT REDRUTH TICKETINGS.

| | Tons | Value | Average |
|-----------------------------|-------|----------|-----------|
| Year 1911 | 6151½ | £702,599 | £114 4 5 |
| Year 1912 | 6492 | £831,908 | £128 5 6 |
| Year 1913 | 6186 | £744,268 | £120 2 6 |
| January to June, 1914 | 2862½ | £263,387 | £92 0 3 |
| July 6 | 232 | £19,416 | £83 13 10 |
| July 20 | 248 | £20,394 | £82 4 9 |
| September 21 | 151½ | £10,944 | £72 4 10 |
| October 5 | 204 | £14,938 | £73 4 6 |
| October 19 | 257 | £17,502 | £68 2 0 |
| November 2 | 238 | £17,963 | £75 9 6 |
| November 16 | 251½ | £20,281 | £80 14 5 |
| November 30 | 265½ | £22,687 | £85 10 7 |

EXPORTS OF TIN AND ORE FROM STRAITS AND BOLIVIA.
Reported by A. Strauss & Co.

| | 1912 tons | 1913 tons | Nov. 1914 tons | 1914 tons |
|---|--------------|--------------|----------------------|--------------|
| Metal from Straits to Europe and America | 59,036 | 62,533 | 5,155 | 56,974 |
| Metallic Content from Bolivia to Europe..... | 21,149 | 24,843 | 473 | 18,503 |



❖❖ REVIEW OF MINING ❖❖

INTRODUCTORY.—The measures for financial relief provided by the Treasury have served their beneficent purpose and the two settlements of November 18 and December 1 passed without any serious trouble. Indeed, the success of the relief arrangements has led to optimistic talk of a re-opening of the Stock Exchange, a step that, by arrangement, cannot be taken without the consent of the Treasury. As yet the Government has not seen its way to accord permission, and we deem it unlikely that proposals for the restoration of the financial mechanism of the Stock Exchange will be acceptable for some time yet. A re-opening of the 'house,' that is, the use of the premises by the members of this proprietary club is quite another thing, and, for climatic reasons only, it seems urgent, to safeguard the health of the brokers and jobbers now compelled to meet in the open thoroughfare of Throgmorton Street. Until the fortunes of war bring a favourable conclusion within sight, it will be dangerous to permit unrestricted dealings on the Exchange. Meanwhile the buying and selling of shares is being widened and the list of quotations is lengthening from day to day. Russian, Indian and Rand shares have risen in several instances and a distinctly better feeling is prevalent.

TRANSVAAL.—The October statistics were so delayed as to prevent publication in our last issue. As we surmised, they were good. At 733,746 ounces the total yield was the highest since June of last year. The labour figures were even better, a small increase of 819 comparing with a decrease of 3755 in the corres-

ponding month last year. The total number of natives employed at the end of October was 170,438 against 148,882 twelve months earlier. The figures for November had not arrived when we went to press.

Among notable features in Rand mining is the highly satisfactory development of the New Modderfontein. This property in the East Rand can now claim 6,300,000 tons of ore in reserve, the average contents being 8'4 dwt. per ton. During the past financial year 2,000,000 tons, averaging 9'2 dwt., was added to the reserve. This compares with a total reserve of 1,560,000 tons averaging 6 dwt., in 1909. Moreover, the working cost has been reduced during the year ending June 30 from 19s. 11d. to 16s. 11d., and has since been further decreased to 14s. 11d. per ton. This is a splendid achievement. The proved ore lies in 205 claims, leaving 844 claims still to be developed. Further additions to the milling plant, for an increase of 40,000 tons in its capacity per month, are to be made when political conditions improve. We congratulate the chairman, Mr. Raymond Schumacher, and the board. The 'New Modder' promises to furnish a brilliant addition to the records of legitimate mining.

Statistics of production will benefit from the commencement of milling operations at the Modderfontein Deep and the State mine, the one with a capacity of 360,000 tons and the other of 600,000 tons per annum. Both will be contributing at full capacity during the coming year, having started preliminary crushing in November and December.

Collapse of ground, due to air-blasts, is reported from the Village Main Reef and the Ferreira Deep mines. In the latter the caving at the 5th level station of the No. 2 shaft-incline will affect the output for several weeks. Our correspondent at Johannesburg discusses the subsidences.

The quarterly report of the Transvaal Gold Estates announces an additional five stamps, and accessory plant, for the Elandsdrift mine and a tube-mill for the Vaalhoek mine.

The mines of the General Mining group did well during the quarter ending September 30, the aggregate working profit showing an increase despite adverse political conditions. Of the six mines under this control, the Meyer & Charlton is the most important, the ore yielding 45s. per ton at a working (not total) cost of 17s. per ton. We note that "140 feet of low-grade assayed 1'29 dwt." This ought not to occur again. Banket assaying 1'29 dwt. per ton is not ore; nor second cousin to ore.

RHODESIA. — A fresh record has been established, the October output of gold being worth £337,241 as against £309,398 in September and £247,068 in October of last year. As an accident to the Shamva tramway at the end of August caused a cessation of milling during the first two weeks of September, the output of the Shamva for that month fell to £17,712, as compared with £31,283 in August and £31,348 in October. Other smaller gains were made by the Bell Reef and Cam & Motor, but these were more than balanced by a further diminution at the Lonely Reef, which during the last three months has yielded £16,800, £13,425, and £11,127 successively. Lack of water is given officially as explaining this serious decrease, but the dwindling grade of the ore treated is suggestive. The cost per ton has risen considerably, from 28s. to 36s. since August, but this is related directly to the diminished tonnage, from 6090 to 4030. The Cam & Motor is still struggling against metallurgical diffi-

culties. Extraction has increased from 57 to 69% since April, but it continues to be far short of anticipations. However, in October an improvement of 4% can be recorded, leaving 16% more to be achieved before the official estimate is honoured. In October the assay-value of the ore treated was only 39s. 9d., as against an average of 44s. 6d. credited to the reserve. The Golden Kopje also is having some trouble with its new plant, the 'absorption' of gold being such as to halve the expected yield. In October it was 15s. per ton, as against an estimated assay-value of 7'31 dwt. in the ore reserve. However, in September the yield was considerably worse, at 11s. 9d. per ton. Meanwhile the working cost has been reduced from 22s. 11d. to 20s. 3d. per ton.

Seldom are mining shares, when once written-down, restored to their original par value. This, however, is the case with the shares in the Wankie Colliery company, which owns an extensive coalfield in Rhodesia. After several years of adversity, owing to lack of cheap transport and to a scarcity of customers, it was necessary in 1909 to reconstruct the company, reduce the nominal value of the shares from £1 to 10 shillings, and raise more working capital. Since then the company has gradually attained the position of a first-class industrial enterprise, and has paid excellent dividends. The capital is to be re-arranged, and two shares of 10 shillings each will be issued to shareholders in place of each one at present held. The new contract with the Union Minière du Haut Katanga calls for 100,000 tons of coal and coke per year.

The erection of the smelter at the Rhodesia Broken Hill lead mine has been delayed, as part of the plant is on a German steamer which is interned at a neutral port. Duplicates have been despatched and the furnace should be completed by March. The ore is oxidized and is high in zinc. It is expected that it will be possible to recover the zinc-oxide fume in bag-filters.

WEST AFRICA.—This mining region also made a new record in October, the output of gold being 38,879 ounces, worth £159,410, as compared with £154,316 in September and £137,153 in October last year. The increase is due to the Abosso, which produced £19,596 as against £16,493 in the previous month, the Broomassie, with £16,652 against £13,653, and the Prestea, with £40,247 against £37,784. Only the Abbontiakoon made a noteworthy decrease, from £23,705 in September to £19,065 in October.

The ore reserve at the Ashanti group of mines, as reported by Mr. W. R. Feldtmann, the consulting engineer, shows an increase of 67,000 tons during the past year, the figure now standing at 432,500 tons, sufficient to keep the mill occupied for four years. The average gold content is unchanged at $19\frac{1}{2}$ dwt. per ton. The richest ore is found in the Obuasi shoot where 213,000 tons is estimated to average 27'3 pennyweights.

The prospects of the Abosso have been brightened by the discovery of a new lode parallel with, and similar in general character to, the main lode. A stretch of 371 feet of ore averaging 37s. per ton for 80 inches has been found in this new lode and vigorous exploratory work is under way. At the Taquah the reserve has only decreased by 7000 tons, although 58,746 tons of ore was crushed during the year. A serious accident to the power-plant impeded operations in the earlier part of the year. However, the loan has been reduced and a second dividend assured.

Mr. Thomas Blair Reynolds, as chairman of the Ranfinpa tin company, had no pleasant task at the recent meeting. The original estimates, on which the company was organized, have proved pitifully fallacious. The ground on which work was started is now recognized to be unprofitable, as was ascertained by Mr. C. H. Wray. Meanwhile Mr. L. H. L. Huddart, the company's engineer, has tried his best to remedy initial errors by finding

better ground in the seven square miles over which the company has mining rights.

CANADA.—Before the war the gold and silver mines of Northern Ontario were obtaining all their cyanide from the Cassel Cyanide Company at Glasgow. On the declaration of war, anticipating a shortage, the mines at Cobalt and Porcupine placed orders equivalent to a year's consumption of this chemical. The Cassel company, of course, was compelled to decline the order, having many other clients to consider. Whereupon the Ontario mines were included in the arrangement effected by the British Government whereby the Cassel company undertook to supply cyanide at 9 pence per pound to mines within British territory to the end of 1915 and for 8 pence during 1916, as mentioned in our September issue in connection with the position on the Rand.

The Mond Nickel company has issued £500,000 debentures carrying 6% interest with the object of securing the necessary capital to complete the extension of the smelting plant at Sudbury, and the refining works at Swansea, and to pay for the development of new properties, particularly the Levack No. 1. The issue was a success, as the money was forthcoming before the lists were closed.

The Granville Mining Company reports the operations of its two subsidiaries, the North West Corporation and the Canadian Klondyke Mining Co. The former is not yet productive, all the work done in 1913 and 1914 being of a preparatory nature, chiefly the stripping of the surface for natural thawing. The delay in production is to the advantage of this process, which is yet to be established as wholly successful. Additional capital, probably £100,000, is required. The war has hindered the delivery of machinery, so that productive operations in 1915 will suffer. As regards the Canadian Klondyke, the output in 1913 was 86,034 ounces of gold, while in 1914 to Octo-

ber 24 it was 61,900 ounces, as against 66,931 to the same date in 1913. The decrease is due to the sinking of Dredge No. 2, which will not come into service until next season. In 1913 the profit, after deducting bond interest, was \$752,557, which was used for capital expenditure. This year's profit is to be available for a dividend.

UNITED STATES.—Financial conditions in New York are improving; the large purchases of war material are restoring the American balance of trade, and the assured increase in the demand for wheat and other grain is creating a firm tone in financial circles.

The 5% dividend declared by Stratton's Independence is due mainly to continued good management at the mine. Mr. Philip Argall and his sons have done well for this famous mine, both by technical skill and economy. During the past year the mill treated 133,875 tons of dump, filling, and remnants for \$1'27 cost and an 80% recovery. Two years supply remains, as from July, on a slowly diminishing margin. Efforts are being made to acquire new property, with a view to continuing the life of the company.

AUSTRALASIA.—We refer editorially to the Zinc Corporation's effort to free itself from its German contracts. Elsewhere also we publish an interesting letter from our Melbourne correspondent.

The Golden Horse-Shoe has been the subject of a bear squeeze. A recent good development has been against depreciation of this splendid old mine. The No. 4 lode re-entered the mine on the 2630-ft. level and has been explored 300 feet deeper, on the 2900-ft. level, where the lode has averaged about 7 feet of 2 oz. ore for 145 feet. At the same time the adjacent property, the Great Boulder, has benefited from a bore-hole extended from the 1300-ft. level of the Perseverance mine; this cut 7 feet of 10 dwt. ore at a distance of 88 feet within the Great Boulder boundary; subsequently, the same bore, 38 feet farther, cut

9 feet of 11 dwt. stuff. This is in ground that heretofore has not been explored.

The Ida H. is a mine with a chequered career, and we are glad that the latest phase is cheerful. During the past year 16,303 tons was crushed for a yield of £53,559, as against 15,253 tons and £36,278 in the previous year. We note with pleasure that the whole of the year's development has been written off, so that the accounts reflect facts. A marked decrease in the angle of the ore-shoot promises to facilitate development. A dividend of 6d. per share is declared and the directors are working on half-fees. Surely the shareholders will be gratified.

MEXICO.—General Villa has reached Mexico City and his military ascendancy appears to be established. We hear from New York that Villa maintains good order in the North and that his firm hand is expected to subdue the other insurrectionary leaders in the South. The American Smelting & Refining Company is operating three smelters, and expects to resume work shortly at the Aguascalientes plant. The general feeling is that the end of indiscriminate brigandage is in sight and that the sadly harassed country will return to a condition of such quiet as will warrant the revival of the mining industry. However, we have been disappointed so often that we can express only a pious hope. Meanwhile the American government has found it necessary to send troops to the border, at Naco, Arizona.

INDIA.—Mr. H. J. Gifford, the superintendent, reports that the developments at the Champion Reef mine during the past year have been highly satisfactory, the whole of the drifts from the 40th to the 45th levels in the section between Glen and Garland's shafts being continuously in ore of excellent width and assay-value. The reserve has been increased and now stands at over two years supply. The tube-mill plant for re-grinding coarse sand before cyaniding started operation at the end of September. The Mysore government

is building a great dam at the Cauvery Falls in order to increase the capacity of the hydro-electric station from which the Kolar mines receive their power.

RUSSIA.—Elsewhere in this issue we chronicle the issue of the Irtysh Corporation, which is to operate the Ridder metal mine and the Ekibastus coal-field.

The unwatering of the Zeranovsk mine of the Russian Mining Corporation has been checked by the delay in the arrival of pumps, due to railway congestion.

At the Spassky the Russian mobilization has caused serious curtailment in several departments, chiefly development underground. The winze from the 630-ft. level is in 22% copper ore. The Atbasar has received 12,000 tons of material for the new plant, this having been carried across the desert in camel carts. There remains 300 tons of the heavier machinery which was delayed by the lack of railway trucks from Petrograd, but the latest news is that this portion of the material has just arrived at Djousali, the shipping point on the Trans-Siberian railway.

CORNWALL.—An important discovery of what appears to be an entirely new lode has been made at East Pool. We hope to give details in our next issue.

Some bunches of high-grade ore have recently been disclosed in the Wheal Kitty, at St. Agnes, and the returns for the current half-year should be substantially improved thereby. This little mine has done well during the last 8 years under Mr. J. H. Collins' direction, though eighteen months ago a temporary set-back occurred owing to the poor results of development. The present discovery is, therefore, all the more welcome.

OIL.—An important extension of Standard Oil influence has been effected by the purchase of control in the Lagunitos Oil Company, the deal being made through the Imperial Oil Company, of Canada, with a subsequent transfer of the Lagunitos to the Inter-

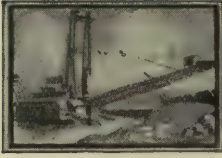
national Oil Company, another Canadian subsidiary of the Standard Oil. A report that the Lobitos Oilfields had also been acquired by the same interests is not confirmed. As the Standard Oil had previously, in April last, obtained a large holding in London & Pacific Petroleum, it is evident that the octopus is extending its tentacles actively in South America. The annual outputs of the three companies mentioned are reported as follows:

| | |
|-----------------------|-------------|
| Lobitos | 65,000 tons |
| London & Pacific | 150,000 „ |
| Lagunitos | 40,000 „ |

VARIOUS.—Molybdenite is now in demand. The new mill at the Knaben mine, in Norway, owned by English people interested in steel manufacture has been started. The water-concentration method of the old mill has been replaced by the Elmore process, which is producing an 80% MoS₂ concentrate.

Misfortunes rarely come singly, as the South American Copper Syndicate knows to its cost. Prospects now are wholly unlike those forecasted at the last annual meeting. Difficulties in the erection of the smelter at Aroa were followed by trouble in the operation of it. Work has now ceased, save for the extraction of a little rich ore to meet the current expenses of safeguarding the mine. Owing to the dangerous character of the wall-rock, it is unwise to extend developments far ahead; hence the absence of data on which to appraise the future capacity of the property. Hence also the company's vicissitudes. Meanwhile, apprehensions are natural, in default of adequate technical information from the engineering staff.

METALS.—The position of copper has strengthened during the past month, and the price is recovering, the quotation for electrolytic now being £60 and for standard £57. Tin also shows an advance at £149. Zinc is quoted at £27, and lead at £19. Antimony is abnormally high at £52. Silver, after falling to 22d. per ounce, has recovered to 23½d.



EDITORIAL



THE annual savings of the British nation are estimated at £400,000,000. The recent loan of £350,000,000 represents less than one year's savings.

TWO MONTHS ago we recorded that Germany had declared mine timbers to be contraband of war, with the object of preventing their export from Sweden to England, where they are required in the coal mines. The Enemy has since taken the further step of including all wood in the embargo, giving as the reason that much of it will be used in building temporary barracks and quarters for prisoners of war.

AT the last meeting of the Institution it was announced that Sir Thomas K. Rose had been selected as president for the ensuing year. The announcement was received with general gratification. An associate of the Royal School of Mines, the author of the metallurgical text-book on 'Gold,' and chemist to the Mint, Sir Thomas was knighted in January for his services to the State. His election to the presidency indicates that the profession joins with the Government in holding him in high esteem. He will make an excellent chairman.

AUSTRALIANS of German origin have proved themselves loyal sons of the Empire, especially in South Australia. In reading the account of the Broken Hill Proprietary Company's annual meeting we note that the chairman was Mr. H. C. E. Muecke, and that an important speech was delivered by the

Hon. A. O. Sachse. We conclude that the latter is a member of the Legislative Assembly, or lower House of Parliament. Mr. Muecke left Germany at the time of the war of liberation in 1848. In any case, the German names belong to men that have taken a worthy part in the development of Australia, and their Teutonic sound involves no present association or sympathy with the Enemy.

WE are requested by our business department to announce the issuance of a reprint of the reports of company meetings appearing in our advertising pages during the past six months, the period covered by a volume of this Magazine. A limited number of these reprints will be available for free distribution.

SUNDRY notable improvements in the apparatus of the oil-flotation process have been devised by Mr. James Hebbard, manager of the Central mine, and applied successfully in the Central and South mills, at Broken Hill. Patents are being obtained, and should prove of importance to the Minerals Separation company.

BANKS are under criticism. The question is raised in the Press, why do not English banks finance business enterprises in the same way as German banks? The answer is that in the old days of private banks and of joint-stock banks with local clienteles, this used to be done. As the big London banks extended their policy of absorption and amalgamation, the terms on which credit was given

were gradually tightened, the security required made more tangible and liquid, and the personal factor between the lender and borrower eliminated. Responsibility for loans has been largely withdrawn from branch-offices, and practically no loans are made except on terms and under circumstances readily understandable at the head-office.

EARLY in December a friendly suit was brought in London to determine whether the courts would adjudicate on the validity of the contracts between the Zinc Corporation and the firm of Aron Hirsch und Sohn of Halberstadt. These contracts, for sale of Broken Hill concentrate, would terminate ordinarily in 1919, and therefore they stand in the way of any new arrangements for the disposal of the Zinc Corporation's metallic products. The Government, we understand, is desirous of facilitating the diversion of business from Germany to new channels and the suit was started under official cognizance. The question is as to whether the contracts are terminated, or only suspended, by the inability of the German firm to receive shipments of concentrate from Broken Hill. The answer of the courts is that no legal basis exists for an adjudication. Further efforts will be made to escape from the impasse. Having regard to the Government's assistance in the matter of the cyanide supply to British mines, we trust that similar steps will be taken to protect the Broken Hill companies in their efforts to continue operations by making new arrangements for the treatment of the lead and zinc concentrates. The matter is one of imperious and imperial importance.

EVERYBODY returning from Russia expresses admiration at the results already evident from the elimination of vodka as a factor in the life of the people. At the beginning of the war the Government, which obtained £81,000,000 per annum from its

monopoly in the sale of vodka, forbade the sale of it throughout the empire. The people are surprised to find that they can do without it; deposits in the savings-banks are increased; children that went barefooted now wear boots; peasants formerly destitute are now comfortable. A national curse has been lifted. Apropos of this, we may mention that both Colorado and Arizona "went dry" at the recent election in America, these two states voting in favour of prohibition. The experience of manufacturers and mine operators in the United States has shown them that the prohibition of public liquor-selling promotes efficiency in the workers, as well as improved ways of living. Russia has found her soul in an hour of national stress. This example will not be lost.

BY COURTESY of the American government, the steamship *Jason*, which brings Christmas presents for the children orphaned by the war, will be placed at the service of exhibitors at the Panama-Pacific exposition to be held at San Francisco from February 20 to December 4 next year. This 15,000-ton steamship will leave England early in January, passing through the Panama Canal, and will take British art and industry exhibits without charge to San Francisco. This display of goodwill ensures not only a saving of money but a safe conduct for exhibits. We trust that it may prove a factor in stimulating the success of the Exposition.

ANOTHER lengthy addition to the roll of honour appears in this issue; altogether we have published the names of nearly 300 mining men that are performing military service. We regret to announce that John Holman, Lieutenant in the 4th Dragoon Guards (Royal Irish), was mortally wounded at Ypres on October 29 and died in hospital at Boulogne on October 30. He was the son of the late J. H. Holman, of the well known

firm of Holman Bros., Camborne. The family has given two other sons to the army, and the firm now has no less than 105 men in His Majesty's forces. This is a great and patriotic record. We also mention, among the casualties, the fact that Mr. J. C. Farrant, of the Hardinge Conical Mill Company, who was in the force of Naval Volunteers that went to Antwerp and helped to extricate the Belgian garrison, is a prisoner of war at Doeberitz, in Germany.

BY a curious mischance, in this country we give the name of 'calamine' to zinc carbonate and 'smithsonite' to the silicate, while our friends across the Atlantic reverse the names, calling the silicate 'calamine' and the carbonate 'smithsonite.' It is well to remember this at a time when the smelting of zinc ores is to the front. We may also suggest that it is about time to abolish this mineralogical anomaly.

THIS YEAR'S Gold Fields meeting was symbolized by the lady shareholder placidly knitting stockings for the soldiers at the front while Lord Harris made one of his characteristically disarming speeches. We feel sure that the lady in question would not have wasted time in discussing the suggestion, made by Mr. Walter Davis, that the directors should forego their fees because the profits of the company had diminished severely. It may be reasonable to ask directors to resign if their administration is defective, but it certainly is silly to expect them to work for nothing during periods of especial anxiety and responsibility. In this case, any suggestion of resignation is stultified by the fact that the policy of the board has been endorsed by the shareholders year after year. We have not endorsed it; they have. It is not only foolish to swap horses in crossing a stream, as suggested by Mr. Lea Smith, but it is grossly unfair to attack a board on counts that were

condoned, if not approved, many years ago. The 'desertion' of South Africa is a departure that we consider highly sagacious, especially when it has been followed by a productive and promising campaign in America, where the Gold Fields is being served by a management of recognized ability. Of course, the times are bad, particularly for market operations. These contributed £300,000 to the company's income in the preceding year, but only £20,000 in the period under review. We hope that this source of revenue may decline further in importance, for, as a means of making money, it has proved prejudicial to the reputation of the Gold Fields. Such operations on the Stock Exchange by a company controlling the management of highly speculative mines, and supposed to exercise technical supervision over them, constitutes a scandal. Many may not agree with this view of the matter and we anticipate that the gentlemen on the Gold Fields board will deem it Sunday-school nonsense, but we feel certain, having some knowledge of mining affairs, that such operations are incompatible with the scrupulous conduct expected of trustees; for that is what directors are, not privileged speculators. So the stagnation that has restricted the activity of the Gold Fields as a gilded jobber is not without its compensations. We hope most sincerely that its success in new fields of industrial activity will be such as to permit the company gradually to keep out of the House and spend more time in the Mine, where is its proper source of revenue.

TRAFFIC through the Panama Canal is already such as to surprise the experts on trans-continental freight. The canal was opened for business on August 15 and has been used by 50 ships, ranging in capacity from 6000 to 12,000 tons, up to the end of October. An example of the effect of this new artery of commerce on the life of interior regions is suggested by the shipment of 15,000

tons of wrought-iron pipe from Youngstown, Ohio, to San Francisco. In this particular case the all-rail rate is 65 cents per cwt., while by way of New York and the Canal the freight is 48 cents, of which 18 cents is the rate between Youngstown and New York, so that 30 cents is the cost from New York to San Francisco. Shipment between these two points is effected in about 20 days, which compares favourably with ordinary transport by rail. Up to November 1 the tolls collected had amounted to \$746,792, notwithstanding delays due to landslides, which twice blocked navigation. The big Cucuracha slide is moving at the rate of about $2\frac{1}{2}$ feet per day and requires constant dredging. However this and other difficulties are not beyond the skill of the engineers in charge. Eventually the slipping of the ground will be terminated by the removal of the superincumbent mass to which the pressure is due. Meanwhile the Canal is a great and beneficent fact.

CYANIDE supplies for mines in British territory are assured, but the American supply is still on a precarious basis. On further investigation we find that the Roessler & Hasslachner plant at Perth Amboy has produced no considerable tonnage in the last year or two, for the total American consumption is about 3000 tons per annum, of which about 2000 tons is imported. Moreover, the Davis Chemical Company, in Massachusetts, contributes a small proportion. The American imports of cyanide, on average, are nearly equally divided between the sodium and potassium cyanides, as the accompanying figures show:

| | 1907 | 1908 | 1909 | 1910 | 1911 | 1912 | 1913 |
|-----------|------|------|------|------|------|------|------|
| KCN..... | 1535 | 1644 | 1376 | 1211 | 1163 | 1048 | 475 |
| NaCN..... | 1074 | 857 | 981 | 649 | 598 | 823 | 943 |

The cyanide used in Mexico is usually shipped direct to that country, but since the prevalence of general disorder some of it has come through the United States. The tonnage is not known. How much of the cy-

nide imported into America comes from Germany, and how much from Scotland, is not stated. The steamer *Sun* is expected at New York with 1000 tons of German cyanide, enough to relieve immediate requirements. No assurance of further shipments can be given. Meanwhile some hope of using 'surrogate' as a substitute is being held forth to mine-owners.

A Biological Necessity.

In his recent speech at the Mansion House the French Ambassador stated that while Europe had suffered invasion from barbarians in earlier times, she had never seen "barbarism raised to dogma, taught by the learned, preached by an intellectual elite; in a word, pedantic barbarism." Among these pedantic barbarisms it is claimed as an axiom that "war is a biological necessity." Indeed, one of their prophets, Von Bernhardt, anticipating victory, states that "war gives a biologically just decision, since its decisions rest on the very nature of things." Moreover, he tries to give pseudo-scientific colour to his theory by claiming that "the sages of antiquity long before Darwin recognized this." Leaving the sages of antiquity, such as Tamerlane, Genghis Khan, and Attila, to be quoted by the apostles of Pan-Germanism, we deny categorically that Darwin ever gave consent to such a doctrine. His own son, Major Leonard Darwin, has gone on record as denying the libel. To Charles Darwin, 'law' was something quite different from the will of the stronger. In 'The Descent of Man' he taught us that "the moral qualities are advanced, either directly or indirectly, much more through the effect of habit, the reasoning powers, instruction, religion, etc., than through natural selection." As his son asserts: "It is the worship of brute force and not the doctrine of evolution that must stand condemned." Moreover, the chief expositor of evolution, Huxley, declared himself unequivocally on

this phase of the subject. In his Romanes lecture at Oxford, one of the last of his great sermons on the philosophy of life, he exposed the fallacy "that because animals and plants have advanced in perfection of organization by means of the struggle for existence and the consequent 'survival of the fittest,' therefore men in society, men as ethical beings, must look to the same process to help them toward perfection." Survival of the "fittest," of course, does not connote best, with a moral flavour. On an earth cooled to arctic conditions, the fittest would be lichens and diatoms, not trees and not men as we know them. Huxley, in splendid periods that echo down the years, showed that while man in a rudimentary state of living is subject to the cosmic process of competitive selection, when he advances into a more advanced stage of society he becomes subject to the ethical process "the end of which is not the survival of those who may happen to be the fittest, in respect of the whole of the conditions which obtain, but of those who are ethically the best." In other words, the cosmic process is modified—is largely opposed—by the ethical process. Biological necessity yields to social amenity. As the great philosopher of the Victorian era said: "In place of ruthless self-assertion it [the ethical process] demands self-restraint; in place of thrusting aside, or treading down, all competitors, it requires that the individual shall not merely respect but shall help his fellows; its influence is directed, not so much to the survival of the fittest as to the fitting of as many as possible to survive. It repudiates the gladiatorial theory of existence." Compare this convincing statement of scientific truth with the crude and shallow dogmatism of Clauss Wagner, quoted approvingly by Von Bernhardt, himself a fitting spokesman of the Pan-Germanic idea: "The natural law, to which all laws of Nature can be reduced, is the law of struggle. All intra-social property, all thoughts, inventions, and institutions, as

indeed, the social system itself, are a result of the intra-social struggle, in which one survives and another is cast out. The extra-social, the super-social, struggle which guides the external development of societies, nations, and races, is war. This struggle is a creator since it eliminates." Here you have the doctrine of Krupp and the Death's Head Hussar; this is the message of the Deutscher Kulturbund. Having emerged from the cave and escaped from the jungle, man is to go back to his ape and tiger existence and to make the earth once more a vast arena for a new gladiatorial combat, which is to be waged intermittently without the check of either treaties or conventions.

As regards the individual, war does not ensure the survival even of the physically fittest. The unfit are rejected and escape military service; it is the brave and strong that are sacrificed. Viewed collectively, the country possessing the larger number of men fit for military service may expect to win, but only as against a single opponent: a war of wanton aggression may unite several countries in opposition. A biologically just decision may be prevented by a politically unjust cause. In short, the animals of the jungle may fight for food, for life, but the battle of *homo sapiens* is based on mental processes of a more complex character. Man may be a fragile reed, but he is a thinking reed, as Pascal said. He is not going to have crass untruths forced upon him even by 'Black Marias' and 'Jack Johnsons,' or any other shrill exponents of the savage lust for conquest. Not even the roar of battle along a 300-mile front can kill our belief that "the intelligence which has converted the brother of the wolf into the faithful guardian of the flock might be able to do something towards curbing the instinct of savagery in civilized man." We do not take our interpretation of evolution from the vulture that masquerades as an eagle. "Might makes right," the Prussian shouts. "That," says Eliot of Harvard, "is the theory of a

savage." It was the brag of that magnified undergraduate Heinrich von Treitschke. It is the creed of the Prussian professor that approves the assassination of Belgium. Are we "to shut the gates of mercy on mankind" and allow the War Beast to smash his way through creation like any megatherium of the primordial slime? No; not even if the thunderous negative must be hurled from a thousand howitzers. Barbarism must be downed by its own weapons, unfortunately; war must make an end of war; but at least we who are the countrymen and pupils of Darwin, Spencer, and Huxley, can repudiate a shallow misrepresentation of the cardinal principles of the great doctrine of evolution, the basic idea of modern philosophy, originated and developed in England, where culture as yet goes peaceful and unarmed, not swaggering in the insolence of kultur, armed from head to foot and spluttering challenge like any village braggart.

Mexican Affairs.

Owing to the compelling interest of events nearer home, the progress of Mexican affairs is receiving scanty attention. Nevertheless, the condition of the distressful republic must not be overlooked by those engaged in mining. We confess that the political cross-currents due to successive revolutions have made it extremely difficult to form any intelligent opinion as to the real trend of recent developments. After Huerta left the country and Carranza assumed the provisional presidency, it was hoped that quiet might ensue. But Venustiano Carranza proved himself an incapable administrator, while, at the same time, his military reputation has been eclipsed by that of his chief associate, Francisco Villa. On March 20, 1913, Carranza was recognized as the leader of those opposed to Huerta, but it was Villa and his troops that drove Huerta into exile. In September last Carranza entered the capital, and shortly there-

after he agreed with all the military leaders of his party to call a conference to appoint an acting president to organize a civil government. This conference met at Aguascalientes and appointed Eulalie Gutierrez as chief executive, but Carranza refused to recognize the appointment, claiming that the conference had been dominated by Villa and his body-guard. Since then Gutierrez has assumed the responsibilities of office and appointed Villa as commander-in-chief. This has driven all Villa's military rivals, led by Antonio Villareal, to the side of Carranza, who finding his position untenable, left Mexico City and established his headquarters at Orizaba, near Vera Cruz, leaving General Obregon in charge at the capital. Obregon declared war on Villa on November 21 but retired with his followers to Salina Cruz, General Blanco remaining as an agent for the new government. On November 16 it was announced that both Carranza and Villa would resign their official posts and leave the country, retiring to Havana on November 25. Queretaro was to become the temporary capital. It was arranged also that the American troops would evacuate Vera Cruz on November 23. This involved the disposal of the \$2,000,000 of custom receipts accumulated during the American occupation. On November 25 the forces of Emilio Zapata, a bandit-in-chief, now friendly with Villa, occupied Mexico City, on the withdrawal of General Blanco and the remainder of the garrison. However, Zapata's men are reported to have behaved properly and good order was preserved. On the first day of December Villa's troops took possession of Pachuca, appropriating all the motor-cars and provisions in the place. The next day he entered the capital. The number of provisional presidents since Diaz is already beyond recollection and it threatens to expand indefinitely. Meanwhile the shifting alignments of ambitious military leaders, mostly of the irregular type, tend to drive

the better class of Mexican out of the country, to Cuba or Spain. The only encouraging feature is the restoration of some semblance of order in northern Mexico, where Villa's firm hand is giving the mining industry a chance to revive. It would seem as if an end of the political chaos might be in sight under Villa's military dictatorship.

The Irtysh Corporation.

At a time when the floating of mines suggests one of the most sinister aspects of war, it is a pleasure to turn to the launching of peaceful enterprise in a historic mining region. In the early part of the year now nearly at an end, we chronicled the successful re-opening of an abandoned mine in the Altai mountains by the Russo-Asiatic Corporation, followed by the similar resuscitation of the Zminogorsk and Zeranovsk mines by the Russian Mining Corporation. Since then the Ridder mine has been kept pleasantly prominent by the publication of periodical reports giving the results of diamond-drilling and other work designed to test the size and richness of an orebody previously made known by old workings on the concession granted by the Imperial Cabinet in the watershed of the river Irtysh. That is the way it is usually spelled, but this financial group seems to think there is much virtue in a Y, as is suggested by the names of the Tanalyk and Kyshtim. However, the sponsors of the enterprise can be permitted to do their christening in their own way. The Ridder, or Ridersk, mine has been tested by them to the stage when it is advisable to form a subsidiary company, so we have the Irtysh Corporation, which has acquired from the Russo-Asiatic the metal mines formerly operated in Siberia under the name of the Ridder Mining Company and the Ekibastus coal property operated by the Kirgiz Mining Company. Here again an unfamiliar spelling is introduced. The nomads of western Siberia are called Kirghiz,

but as the omission of the h was an inadvertent error, it has no particular significance. The Irtysh Corporation starts with a working capital of £500,000, provided by the successful issue of an equal number of debentures. Of the 2,000,000 shares, the vendor company receives 1,100,000; a block of 200,000 is held for conversion at the option of the debenture-holders, while another block of 200,000 is kept for future disposal as required. Of the remaining 500,000 shares, one half represents rights of debenture-holders to purchase at par and the other half is set aside for options at par conceded to the underwriters of the debenture issue. The share-options are inherent individually, they are not attached to the debentures themselves, so that gambling in options is prevented, for it would not benefit the company. The financial arrangements are satisfactory in that they are framed with a view to the success of the enterprise itself and not of the flotation only. The Ridder and Kirgiz properties were operated originally through trustees for the Russo-Asiatic, the two subsidiary companies being organized during the past summer. When the concession was acquired and a preliminary inspection had been made, it was decided to limit work to the most promising of the several mines on the property. The Ridder was selected, and on it attention has been concentrated. However, the Sokolny also gives signs of having been important formerly, the dumps being large enough to suggest orebodies comparable to those of the Ridder; it evidently has been worked below the zone of oxidation. On the other hand, the Krukovsky is bare of dumps, all of which consisted probably of oxidized ore that has been removed for treatment in the old stamp-mill. These workings are caved and inaccessible, but will doubtless be investigated at a later date, when the Ridder has reached a productive stage.

At the time of the Russo-Asiatic meeting,

last January, the chairman, Mr. C. J. Cater Scott, made sundry statements based upon the results of the first borings. Now we have an independent report by Mr. H. H. Knox, who returned from the mine in November. It is satisfactory to note that he is able generally to confirm the earlier anticipations. A year ago it seemed as if the proportion of gold would be higher, and it was deemed convenient to divide the lode into three distinct parts, labelled 'solid sulphide,' 'concentrating ore,' and 'gold-bearing hornstone.' It is now apparent that the average gold contents are less than was indicated by the first two bore-holes and that the distinction made between the concentrating ore and the hornstone is one that can be disregarded in practice. We find Mr. Knox's geological diagnosis satisfactory; it fits the facts and it is in harmony with other examples of this type of ore deposit. The lode lies in shale near a dike so decomposed as to defy petrographic identification. The shale, which has been folded and here dips at a low angle, has undergone varying stages of decomposition and enrichment, the portion on the hanging-wall side of the lode being replaced by a nearly solid band of mixed sulphides succeeded by less mineralization and more intense silicification, culminating in the hornstone near the foot-wall. Evidently this lode is the product of thermal activity following in the wake of the intrusion to which the dike owed its existence. A series of six double bore-holes has given the samples and widths on which the richness and size of the orebody are estimated. A length of 750 feet has been proved; the solid sulphide averages 36 feet in width, while the concentrating ore is taken at 110 feet. These tests have gone down to a depth of 700 feet on the dip or 540 feet vertically. The solid sulphide has a gross value of £14'91 in gold, silver, lead, zinc, and copper, while the concentrating ore averages £4'73. The average cost is estimated at £2'38, leaving an average profit of £3'03 on

the 2,448,000 tons, of which 883,000 is solid sulphide and 1,565,000 is concentrating ore. Thus the profit, omitting depreciation and amortization, on the ore assured is estimated at £7,400,000.

The metallurgical tests on the solid sulphide ore by water concentration alone gave 93'6% of the gold, 75'5% of the silver, 57'5% of the copper, 73% of the lead, and 75% of the zinc, leaving mixed products for re-treatment. Mr. W. G. Madge, who conducted the tests, considers it safe to expect an extraction of 97% of the gold, 84% of the silver, 73% of the copper, 85% of the lead, and 86% of the zinc, in the form of several concentrates, after adding the supplementary recoveries. On the remainder of the lode similar tests lead Mr. Madge to expect an extraction of 94% of the gold, 74% of the silver, 67% of the copper, 82% of the lead, and 80% of the zinc, similarly in the form of concentrates, ready for further reduction by smelting. Water-power to the extent of 5000 h.p. is available from a stream situated 6 miles from the mine and a plant to generate 1500 h.p. is to be erected forthwith. Mr. A. P. Ivanoff, managing director of the two Russian companies, is going to the Altai to let contracts for the construction of the railway from the mine to the Irtish river at Ust Kamenogorsk. The testing-plant is being enlarged to a 100-ton mill and will be running, it is hoped, next summer. Concentrate should be shipped before the close of navigation next year to the smelter-site on the Ekibastus coalfield, the first unit of the smelter to be available at the beginning of 1916. We need hardly add that Russia affords an assured domestic market for all the metals, and we are informed that the coal will be readily absorbed by both the Government railways and the river steamers. So the outlook is cheerful. We have given a full account, believing that the information will be welcomed at this time, when so little new enterprise is practicable.

Moreover, the undertaking has won our goodwill by the manner in which it has been conducted so far and by the significant fact that the board of directors includes three graduate mining engineers, Messrs. R. Gilman Brown, H. C. Hoover, and D. P. Mitchell. In addition, Mr. H. H. Knox, as consulting engineer, brings a further guarantee of wholesome methods. We wish the Irtysh Corporation unqualified success, and hope it may prove to be only one of many joint British, American, and Russian enterprises in the beautiful Altai.

Persistence of Ore.

The discussion of this subject at the recent meeting of the Institution led to a debate of unusual interest and animation. That the subject is vital was fully recognized in a manner that must have been gratifying to the author of the paper, Mr. T. A. Rickard. His first writings on the subject go back so far as to suggest that the present paper represents a matured opinion. While he attacked the problem as a mining engineer of wide experience, it is fair to say that his frankness of statement was facilitated by the fact that he is now no longer a practitioner, having passed into another profession, more accustomed to unfettered utterance. Obviously an editor can lay emphasis on the mortality of mines with less embarrassment than one engaged in giving advice to mining directors or companies, to whom any apparently undue check upon optimism is repellant. However, the editor of a mining periodical may be as solicitous for the welfare of the mining industry as any mining engineer in practice. In his introductory remarks the author dwelt upon this point, insisting that the recognition of facts did not involve a gloomy outlook upon mining exploration, but that the restrained use of the constructive imagination might tend to divert money from wild ventures to hopeful prospects. Mining in its legitimate aspect,

which is the only one that should concern the profession, does not gain by the spending of capital on impossible schemes or by throwing good money after bad when once a mine is bottomed; on the contrary, the supply of capital being limited, the more of it that is squandered, the less of it is there available for sane ventures and reasonable risks. It is the duty of the mining engineer to render the employment of money in mining safe and productive, within the limits of reasonable risk.

At the outset the author of this belligerent paper was able to announce that at the end of September the St. John del Rey workings had reached an extreme vertical depth of 5711 ft. This makes it the deepest mine in the world, taking the record from the No. 5 Tamarack shaft, which at 5368 feet has hitherto been the deepest shaft sunk in search of ore. We congratulate the St. John del Rey company, which has administered this splendid property without cocking an eye at the share-market, so that it has escaped the scandals that so often disfigure the records of successful enterprise. As the St. John del Rey happens to contain the most persistent gold-bearing ore-shoot as yet uncovered by the miner, the honourable record of the management is of particular significance. In his paper, Mr. Rickard gives a description of this remarkable ore deposit, together with the statistics of production, from which we may quote the total yield of £10,665,944 from 5,313,028 tons, or an average of 39s. 11d. per ton, affording dividends and tax-payments to the amount of £2,183,366. The St. John del Rey, in its extraordinary persistence, is a striking exception to the ordinary experience of mining, as, for example, Gladstone, holding the House of Commons spell-bound when he was 84 years old, was an exception to the Psalmist's generalization that the span of life is "three score years and ten." The super-man emphasizes our essential mortality, as the super-mine reminds us that mines have their day.

By a coincidence, probably not unwelcome to the Council of the Institution, the paper was read while the Stock Exchange was closed. The cause of gloom on Throgmorton Street is one that, of course, we all regret; and we shall join heartily in welcoming the renewal of facilities for that reasonable speculation in shares which, while not essential to mining as an industry, is so stimulating to it as a business. However, the absence of the usual quotations was undoubtedly favourable to a discussion on persistence of ore. There was no desire, least of all upon the author's part, to throw cold water on legitimate enterprise or to emphasize unduly the risks inherent to mining. Those risks are compensated by proportional gains, and the frank facing of them is the way to diminish their perturbing incidence upon mining activity. The author referred humorously to the fact that, many years ago, when State Geologist of Colorado, he was charged with depreciating the mining industry, because he denied the general enrichment of ore in depth, as also he was attacked for denying the natural equality of man, the latter being deemed in sundry quarters as a reflection on American democracy. The charge on both counts provoked a good-natured laugh at Denver, where the sense of humour is heightened by the altitude above sea-level. In London, and among those engaged in mining, Rousseau's fallacy, which Huxley smashed, has been consigned to the limbo of discarded theories, but the comforting notion of indefinite persistence of ore survives as the wraith of the bolder doctrine of enrichment in depth. Mr. Rickard tilted against the fallacy not without visible success, but we join with those that were present in acknowledging that the most effective stroke was that of Mr. Walter McDermott, who, with one or two rapier thrusts of wit punctured the iridescent bubble that has buoyed so many flimsy expectations of joint-stock finance. He said that most men of experience would

agree "that there was a painful number of instances of mines which rapidly got no better with depth" and, after all, "what a merciful dispensation of Providence it was that the poor ends of mines were not stuck in the air." Let us leave it at that for the present, reserving further comment until the discussion is concluded.

Iron and Coal and the War.

In recent issues we have discussed the lead, zinc, and copper problems, the effect of the war on the curtailment of their production, and the influence of the metal supply on the outcome of hostilities. It remains for us to review the coal and iron resources of the countries at war, and to recount the incidents affecting the industries founded on them. Naturally coal and iron play a far larger part in a nation's prosperity than do lead, zinc, and copper, and the study of their occurrence and application is proportionately wider and more complex. It is obvious that we cannot hope to give a complete survey of the world's figures and records within the limits of an editorial article, and we are obliged to confine our remarks to the industries of Great Britain and European countries. The chief incidents connected with the war are the capture, at least temporarily, of the Belgian and North French coalfield and of the iron ore deposits of French Lorraine; the stoppage of shipments of Spanish iron ore and Russian and Indian manganese ore to Germany; and the inefficacy of the proposed declaration on the part of Great Britain of Swedish ore as contraband. The only inconvenience suffered by Great Britain is an indirect one, namely, the declaration by Germany of mine timber as contraband, a declaration subsequently extended to all wood from Sweden. Germany is not seriously affected by the embargo on Spanish ore, but the cessation of supplies of manganese ore may interfere with steel manufacture, where ferro-manganese is employed for regulating the amount of carbon content.

As for the attempt of Great Britain to declare Swedish ore contraband, such a proposal must necessarily have failed, as we had no means of enforcing its recognition, because it is carried across the Baltic.

In examining the coal and iron resources of the various countries, we take Great Britain first. The yearly output of coal is about 270,000,000 tons, or 30% greater than that of Germany, and only second to that of the United States. The chief coalfields are in South Wales, Northumberland and Durham, Yorkshire Nottinghamshire and Derbyshire, South Lancashire, Warwickshire and Staffordshire, Denbigh, West Cumberland, Gloucester and Somerset, and Kent; in Scotland, Lanark, Fife, and Midlothian. As regards Ireland, two-thirds of the present surface was at one time covered with Coal Measures, but nearly all has been denuded, leaving the limestone floor exposed. Those remaining are much contorted, and are compressed in places, so that the beds resemble irregular veins rather than seams. The outstanding developments in connection with British coal mines in recent years have been in the eastern extension of the Yorkshire coalfields, where sinkings, in the nature of deep levels, have proved enormous additions to our resources, and in the Kent coalfield, where results have been less promising. Much has been heard of German ownership of English coal-lands. The only case of actual German possession is at the Harworth estate on the border of Yorkshire and Nottinghamshire, purchased last year by Hugo Stinnes, a powerful German coal merchant. German workmen were imported last March to conduct the sinking operations, and they were interned at the commencement of the war. The Whitworth estate, near Neath, in South Wales, was bought by A. de Freitas, of Hamburg, partly with the aid of English capital, and the board of directors was chiefly English. The project, however, has been a failure, for the water in the overlying strata

effectually checked all attempts at sinking, and operations ceased two years ago. German money and boring methods have been applied at some of the Kent properties, but not in an obtrusive manner, and always in conjunction with strong English interests. Probably more French than German money has been employed in the Kentish operations; in fact, the Stonehall colliery is essentially a French enterprise. The final aspect of British coal production to be noted here relates to the export. We find that about one quarter of the output is sent abroad, France, Italy, and Germany having been the best customers, with ten, nine, and eight million tons per year respectively. Practically all the other Continental countries also take our coal, and large amounts are shipped to Northern Africa and South America.

The output of the British iron mines has remained fairly steady during the last forty years, at from 14 to 18 million tons per year. The chief centres of production are the Cleveland district of north Yorkshire, where the ore is carbonate and is found in the Lias; Northamptonshire, Lincolnshire, and Leicestershire, where carbonate of Oolite age is worked by open-cut; Cumberland and North Lancashire, where hematite is won from Carboniferous limestone; and Lanark in Scotland where the ore comes from the Coal Measures. The development of ore in Northamptonshire and adjoining counties has, during the last twenty years, made up for declines in the other districts. During forty years the amount of ore imported has gradually advanced from one to seven million tons, and as these ores are much richer, being hematite and magnetite, they play a larger part in the British iron industry than the figures for tonnage would indicate. More than half comes from Spain, and the other chief countries of origin are Sweden and Norway, Algeria and Tunis, Greece, France, and Russia.

The most important iron ore deposit in

Europe is that which extends through French and German Lorraine, the Duchy of Luxemburg, the south of Belgium, and Westphalia. The total yearly output is nearly as great as that of the Lake Superior district, the proportion of the world's production being 28 and 30% respectively. The ore is found in beds between the Lias and Oolite, and in the early days its phosphatic, calcareous, and silicious admixture rendered it unsuitable for steel manufacture. So poor an opinion had the metallurgists of its virtues that they christened it 'minette,' a term associated in French slang with the lowest depths of moral degradation. However, an Englishman, Sydney Gilchrist Thomas, invented a process capable of treating it to advantage, and since then the deposits have constituted the chief source of supply for the French, Belgian, and German ironmasters. The nick-name is now employed, much to the wonder of our French friends, as a technical term throughout the world, having been adopted innocently by scientists who were unacquainted with its original meaning. After the war of 1870, the Germans had good commercial reasons for annexing the part of Lorraine containing the deposits known at that time. Since then, French Lorraine, included within the department of Meurthe-et-Moselle, has been proved to contain even larger deposits, and permanent possession of the region around Briey is coveted by the Enemy. The Briey and Longwy districts are at present under German military rule. Before the war began, some of the mines were in the hands of German ironmasters, and the output of some of those operated by French interests was partly sent to Germany. In return, the French ironmasters received coal and coke from the Saarbrück coal district in the adjoining Rhenish provinces. Other iron ore deposits are found in Normandy and Brittany, where also German ironmasters have purchased controlling interests. Iron ore is mined in the southwest

of France at the foot of the Pyrenees, and large supplies are drawn from Tunis and Algeria. Of all the great countries of the world, France has the poorest endowment in the way of coal deposits, so that she has been dependent for her supplies largely on England, Belgium, and Germany. Her chief coalfield is in the départements of the Nord and Pas de Calais, with Valenciennes as the commercial centre. This is, as it were, only the tail-end of the famous Belgian coalfield, which extends through Mons, Charleroi, Namur, to Liège, and over the border to Aachen. Central and southern France is dotted with numerous small coalfields. Before passing from the consideration of French and Belgian iron and coal resources, it should be mentioned that the famous iron-works at La Creuzot near Chalons was founded by Schneider, an Alsatian of the days prior to the Franco-Prussian war, and that the coal deposits of Belgium and northern France are so faulted and folded as to require high technical skill in their development.

We have already said that Germany draws large supplies of low-grade iron ore from Lorraine, Luxemburg, and Westphalia. These have been supplemented by imports of hematite from Spain and magnetite from Sweden. None is now being received from Spain, but shipments from Sweden are uninterrupted. The only grievance that Germany has against Sweden is that the rulers of the latter country strictly limit the yearly export of ore. Of late years other sources of ore have been sought by the Germans, a notable case being the Mannesmann enterprise in Morocco.

Germany is rich in coal resources, a fact that explains her industrial development. The Westphalian coalfield is the most important. It extends from the Rhine up the valley of the Ruhr, and within its area are the great engineering centres of Düsseldorf, Dortmund, Bochum, Duisburg, and Essen. We have already mentioned the Saarbrück coalfield ex-

tending through Rhenish Prussia into the Palatinate. The mineral wealth of the German Empire is not confined to the westerly provinces, for Upper Silesia contains a coal-field only second in importance to that of Westphalia. Germany also has enormous deposits of lignite, notably in the district west of Cologne, and in Saxony, Brunswick, and the adjacent parts of Prussia. The lignite forms an excellent material for the manufacture of power-gas, and yields by-products valuable to the chemical manufacturer; moreover, after drying, it is briquetted, and in this form has a wide application as domestic fuel.

Germany's associate, Austria-Hungary, is another country of remarkable mineral wealth, and many of the provinces of that ramshackle empire have been producers of minerals and metals of one kind and another from the earliest times. The Silesian coalfield extends into Galicia and Moravia, and other important coal deposits are found in Bohemia and Hungary. Lignite is mined in several places. Deposits of iron ore are worked in Bohemia, to the north and south of the Carpathian mountains in Galicia and Hungary respectively, and in the alpine provinces of Styria, Carinthia, and the Tyrol. The iron and steel centres at Kladno in Bohemia, Witkowitz in Hungary, and Leoben in Styria are of world-wide repute.

Russia has many coalfields, of which the Donetz basin inland from Odessa takes first rank. The quality of the coal is high, and a great variety is produced, ranging from gas-coal to steam-coal and pure anthracite. The second in importance is the Dombrova basin in the southwest of Poland, which is a continuation of the Silesian and Galician coal-field. In the Moscow basin the quality of the coal is not so high, and the same may be said of the deposits on the western side of the Ural mountains. In Siberia many coal and lignite beds are known, but with the exception of those at Ekibastus, which is being de-

veloped by the Russo-Asiatic Corporation, they are not of notable value. Iron ores are found plentifully in many parts of the empire. The largest production comes from the Odessa district, where an iron industry was founded many years ago by an Englishman, John Hughes. The iron deposits of the Urals, of course, are known to our readers. The deposits of magnetite in Russian Lapland are being developed, and promise to increase in importance. The manganese deposits of the Caucasus constitute a valuable Russian possession, though its monopoly has of recent years been broken by shipments from India. Of the remaining belligerent countries, Servia has extensive lignite deposits, and Turkey is developing coal seams on the Black Sea at Heraclea, 200 miles east of Constantinople. In the neutral countries of Europe, the outstanding features are the iron deposits of northern and southern Spain, around Bilbao and Almeria respectively, and those of central and northern Sweden, with one or two mines over the border in northern Norway. The deposits in northern Sweden and Lapland are enormous, and their limits have not yet been determined. Coal is extensively mined in the northern provinces of Spain. Portugal has hematite deposits of good quality, but they are not worked regularly. Italy produces iron ore in the island of Elba, and lignite in Tuscany. Greece has several valuable hematite deposits, and lignite is mined in the Balkan provinces. Holland has workable coal seams adjoining the Belgian and German coalfields. Denmark has no mineral production whatever. To summarize, England, Germany, Austria, France, and Belgium have well established industries based on coal and iron supplies; Russia has immense resources not yet fully developed; while of the neutrals, Spain and Sweden are great producers of iron ore, which is smelted in countries either better supplied with fuel or endowed with more suitable labour.

PERSONAL.

WILLIAM BACH has returned from the Yenesei government, Siberia.

C. BEADON sailed for India on November 12.

S. W. BELL has returned from Northern Nigeria.

H. C. BELLINGER has gone to Chile to report for the Braden Copper Co.

A. G. M. BEVAN and HENRY REEVE left for Nigeria on November 13.

ALEXANDER COLLEDGE has arrived from Ipoh, Malay States.

J. J. COLLINS is in charge of the Rafinpa mine, in Northern Nigeria.

GEORGE P. CHAPLIN has been promoted to captain in the Royal Garrison Artillery.

E. B. CURRIE has volunteered for military service in Nigeria.

D. A. CURRIE sailed for Penang on November 14.

H. S. DENNY expects to leave for Mexico early in January.

A. J. EVELAND has gone from New York to Pachuca, Mexico.

R. FARINA is on his way to the Caucasus.

J. H. FENNELL, who was a passenger on the *Troilus*, which was sunk by the *Emden*, has returned to England.

GEORGE A. GUESS has spent some time at the new Anyox smelter of the Granby Co., British Columbia.

E. M. HAMILTON sailed for New York on November 21.

H. C. HOOVER, in his capacity as chairman of the American Commission for Relief in Belgium, made a visit to Bruxelles early in December.

W. J. HUMPHRIES has returned from the Gold Coast.

CHARLES HUNTER is expecting to go to Central America.

R. OWEN JAMES has returned from Canada to his home at Wallasey, Cheshire.

BENEDICT T. KITTO, until recently in business with his father, the well known analyst, is now a trooper in the Royal Bucks Hussars.

H. H. KNOX is returning to New York.

HAROLD A. LEWIS has been appointed manager for the Porco Tin Mines, Ltd., in Bolivia.

HAROLD MACANDREW, D.S.O., captain in the 9th Lancers, has gone to the front.

W. MACDONALD, formerly on the Waihi staff, has arrived at San Francisco.

A. N. MACKAY has returned from La Salada, Colombia.

R. K. McDERMOTT is with the Cameron Highlanders at the front.

J. G. MCKINLEY has resigned as manager of the Abosso mine and is attached to the Flying Corps.

EDGAR L. NEWHOUSE and CHARLES A. H. DE SAULLES, of the American Smelting & Refining Company, are in London.

LLEWELLYN PARKER has gone to Rio Tinto.

MAURICE PERCIVAL is on active service in Northern Nigeria; he served throughout 1899-1902 with the South African Light Horse.

C. W. PURINGTON leaves for Boston on December 15.

PHILIP RABONE has joined the Rhodesian contingent.

FRED. B. REECE has returned from Arizona to enlist.

F. G. A. ROBERTS has been appointed technical advisor to the Transvaal Chamber of Mines.

W. L. SAUNDERS is to be the next president of the American Institute of Mining Engineers.

H. R. SLEEMAN starts on December 18 for Western Australia.

RALPH STOKES has gone to the front with the 1st London Royal Engineers.

ARTHUR E. TAYLOR, of John Taylor & Sons, accompanied by ERNEST R. WOAKES, sailed on November 7 for India.

H. BISSELL THOMAS has returned from the Altai, where he assisted H. H. Knox in his examination of the Ridder mine.

WILLIAM THOMAS has been appointed to the command of the 1st National Reserve company, enrolled in Cornwall and now on duty at the National Explosives Company's works at Hayle. This unit is attached to the 4th battalion of the Duke of Cornwall's Light Infantry.

ARTHUR WADE is examining oil occurrences in South Australia.

A. G. B. WILBRAHAM, for four years in the H.A.C., has received a commission in the Royal Anglesey battalion of the Royal Engineers, Chatham, and is about to go to the front.

H. V. WINCHELL was at Grass Valley, California, recently.

HALLETT WINMILL sailed for Siam on November 14.

THE ROLL OF HONOUR.

Additions to lists published in October and November.

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| ALSTON, B. T. South African Force. | KITTO, BENEDICT T. Royal Bucks Hussars. |
| ARMYTAGE, K. E. Dispatch Rider, Expeditionary Force. | LAKE, H. W. Army Service Corps. |
| BALL, F. M. 2nd King Edward's Horse. | LAURIE, R. B. Royal Engineers (T). |
| BECKHUSON, D. F. Royal Fusiliers. | LETCHER, OWEN Imperial Light Horse, S.A. Forces. |
| BERESFORD LEES, P. 3rd Northamptonshire. | LUSH, F. M. 2nd King Edward's Horse. |
| BEVAN, THOMAS Sportsman's Battalion, Royal Fusiliers. | MANSFIELD, F. T. Royal West Kent Regiment. |
| BLACKFORD, D. L. Royal Fusiliers. | MESSERVY, E. D. 1st Surrey Rifles. |
| BLANDY, S. H. B. R.H.A. Somerset. | MUNBY, E. J. Royal Engineers. |
| BOYES, H. H. W. Lothians & Border Horse. | MYBURGH, P. R. H. Fife & Forfar Yeomanry. |
| BROWNE, O. M. 1st King Edward's Horse. | NICHOLAS, W. L. J. The Buffs (East Kent). |
| CLIMAS, A. B. Royal Field Artillery. | OUTRAM, H. W. S. Royal Engineers (T). |
| COTTON, D. C. Royal Field Artillery. | OWLES, GEORGE E. Royal Engineers (T). |
| CROPPER, C. H. 11th Northumberland Fusiliers. | PARTRIDGE, R. W. 88th Victoria B.C. Fusiliers. |
| CURRIE, E. B. Nigerian Force. | PERCIVAL, MAURICE Nigerian Force. |
| DIXON, H. G. DACRES Royal Buckinghamshire Hussars. | PLOWMAN, G. H. Middlesex Regiment. |
| DOUGLAS, JAMES D. Royal Garrison Artillery. | POMEROY, H., JUN. King's (Liverpool) Regiment. |
| EDWARDS, G. MAITLAND Royal Garrison Artillery. | POOL, JAMES G. Duke of Cornwall's Light Infantry. |
| EYDEN, H. Royal Garrison Artillery. | POORE, A. T. M. Royal Irish Rifles. |
| FRANCIS, M. A. The Welsh Regiment. | RABONE, PHILIP Rhodesian Contingent. |
| GODDEN, R. A. 6th Seaforth Highlanders. | ROBERTS, GEORGE J. Royal Engineers. |
| HAND, W. C. Royal Garrison Artillery. | SEVERNE, H. F. Sherwood Foresters. |
| HILL, HENRY W. Sportsman's Battalion, Royal Fusiliers. | STUART, F. MAXWELL East Riding of Yorkshire Yeomanry. |
| HOLMAN, A. T. Honourable Artillery Company. | TAYLOR, G. S. M. Royal Engineers (T). |
| HOLMAN, P. M. Royal Field Artillery. | THOMAS, WILLIAM 4th Duke of Cornwall's Light Infantry. |
| HOLMAN, BERNARD W. Royal Naval Division. | TILLY, GEORGE A. Queen's West Surrey. |
| HUDDART, L. H. L. Nigerian Force. | TIMMIS, F. W. Royal Garrison Artillery. |
| JESSOP, H. J. 2nd King Edward's Horse. | VIVIAN, E. W. G. Armed Motor Corps, South Africa. |
| JONES, A. MOWBRAY Rand Light Infantry, S.A. Force. | WILBRAHAM, A. G. B. Royal Engineers. |
| KERR, HUGH R. Norfolk Regiment. | WILLIAMS, J. E. G. Royal Engineers. |



SPECIAL CORRESPONDENCE

MELBOURNE.

The War.—The position in Australia is the most remarkable seen since the fateful collapse of the boom in the nineties. For ten years the Commonwealth has enjoyed unexampled prosperity. Year after year good seasons added to the wealth of the people and the high range of prices for commodities brought in profits not only to the pastoralist and the agriculturist, but to the miner. Now the whole population has to face a drought even worse than that of 1902-3 with sheep dropping dead by scores of thousands on the runs and with crops an absolute failure. This would be bad enough even if there were no other trouble. But on top of everything has come the war. Then too came a general election that tossed the Labour party into the supreme command of the finance of the country. This is regarded by many as a national misfortune. The reverse may be the case, for, with a strong majority, important problems can be faced with a strong hand, whereas, if any party was in power with a bare majority there might be vacillation and consequent muddling of issues. The danger is that as there must be universal distress labour may imagine that the only way to avert this will be to impose penal taxation. A foretaste of what the leaders have in their mind has been furnished in Western Australia, where the party has proposed to impose an Emergency Tax of 1% on each £100 earned by any person, firm, or company until 15% is charged. Imagine what this will mean to mining companies having large incomes like the Great Boulder, or the Ivanhoe, to say nothing of the lesser lights like the Sons of Gwalia and the Horseshoe. In New South Wales the metropolitan labour organizations propose a tax on incomes above £150 per annum of from 10 to 20%. This has not got to the caucus yet, but that in the East and in the West where labour rules such taxation should be even considered is a pointer a wise man cannot disregard. It may not be within the scope of a periodical devoted to mining to deal with is-

suces of the kind, but it must not be forgotten that the worker is prepared to face complex problems with all the fervour of Louis Blanc and with as little dread of the consequences. The financial outlook over-rides everything, and as profits are sure to be the subject of taxation to keep the wheels moving, the investor has to estimate his position from the elevation of the Labour party, not from the path of proved economics.

Metal market.—The war has done us good in that it has brought to the people here a sense of the way in which the trade, commerce, and finance of this country are interlaced with those of other nations. In principle we as a community attach ourselves to the protectionist party and we give a preference to the British trader. While this is so, many of our leading company directors have deliberately favoured the Continental ore-buyer because his bids undercut the local smelter or because he saw the advantage of a close connection with powerful Continental combinations that deal in shares and metals as opportunity offers. War has brought such people face to face with a set of conditions they were unable to realize as possible. All the big metal-producing companies have had to submit to a suspension of the buying clause of their agreements with the Continental ore-buyer. This has thrown the silver-lead mines of Broken Hill and the copper mines of the Cloncurry district into either complete or partial idleness. Had it not been that the Broken Hill Proprietary Company, with a public spirit that has elicited the warmest approbation, offered to smelt lead concentrate for some of the leading Broken Hill companies, almost every mine would have had to shut-down. Apart from the Proprietary, the Sulphide Corporation treats its own ore, and these smelt and refine the bullion. So far the other companies have not entered into any agreement for the refining, and, as buyers will not take bullion, products are being accumulated on this side. The Proprietary company is fortunate in having the run of the Eastern market, but how far its

association with the lead convention—a combination in which German houses have a big interest—effects European dealing, no one is permitted to know. But people here cannot help wondering whether the King's proclamation respecting dealing with the subjects of an enemy nation would apply if the Convention agreement should happen to be acted upon. It must not be imagined that the representatives of German houses are not trying to retain their trade. In some cases proposals have been made to sell metals to Dutch houses, but the national sentiment is so strong here that the tempter finds little or no encouragement. There can be no question that some of the directors of mining companies here would like to see contracts with Continental buyers annulled, in order to divert the trade to Great Britain, but the fact that the agreements are only suspended during the continuance of hostilities prevents that. On the other hand a grave suspicion exists that some directors are so sympathetic with their old Continental associates that they claim for German friends a treatment that no German leader of thought in his own country would dare to suggest for a Briton. Yet a great opportunity exists for the British people to send out representatives while the patriotic impulse is so strong to pave the way for Britain to acquire again the control of our metal output. The export-duty idea, it may be added, has found favour with the Labour party, and it may materialize in respect to lead and to blister copper. For that reason, if for no other, the directors of the Zinc Corporation, who at one time proposed to put up lead smelters in England, will do well to await the turn of events. So far as zinc concentrate goes, we have insufficient material to incur the huge expenditure necessary to erect new plant, especially as there is no guarantee that when the war is over the control of the output will not automatically relapse into the hands of German dealers once again. From what has been written it can be seen what a great upset has been occasioned in all our leading mining districts. The State governments have helped by offering to make advances against products. This is being done to keep the working population from starvation. Economically what must happen, if we cannot export, is that the accumulation of stocks will menace prices when trade revives. That consideration, however, carries little weight when balanced with the need to provide for the daily food of the multitude.

New Mining Developments have not been numerous of late and so the tightness of

money has led to the withdrawal of capital from a number of our progressive gold mines. Ballarat and Bendigo, Charters Towers, and the outlying areas in Western Australia all have suffered. Had there been any fresh attraction the capital for investment would have been forthcoming, but with that absent, the shadow of the war is threatening to obscure the industry. About the only mine to command notice is the Edna May at Weston, not far from the Bullfinch, in Western Australia. Here from the conglomerate at the surface down to 225 ft. on the underlie a big lode has been followed, the ore assaying about 80s. per ton. The point of interest is that to that depth the shoot consists of oxidized material. The country is said by some geologists to be 'granite,' by others to be a 'gneissic schist.' In point of fact it seems to be the first named. The prediction therefore is made by more than one geologist that directly the primary rock is reached, the fate of the mine will, like so many others in the locality, be determined. Nowhere else in Western Australia has any development of importance taken place. Some criticism has been directed at the management of the Great Boulder company because it has elected to continue its investigation of the old Magdala-cum-Moonlight mines at Stawell in Victoria. These are big low-grade lodes that range in yield so close to what Mr. Richard Hamilton regards as the pay-line that he is spending more money to test them at 1400 ft. In this connection it has been suggested that a new crusher, in which Mr. Frank Powell is interested, should be utilized to lessen costs. At the moment the possibilities of the plant are being investigated. Should it stand the test it will be of use to other low-grade properties.

In North Queensland the whole mining industry has felt the depression. Mount Elliott is doing a little work and is preparing for the opening up of the mines, including the Dobbin group, which it has agreed to finance. The Hampden has resumed work on the half-time system, but it would appear as if the Australian worker, instead of being grateful for being given employment, is regulating his efficiency to the time allotted him. A more foolish act could not be imagined. In the bottom level of the company's Duchess mine high-grade bornite is being developed. Apart from this the development work calls for no comment. On the other hand, the Mount Cuthbert, near the Dobbin group, is proving high-grade copper ore in its Kalkadoon mine, so that the company will soon be able to re-

port the possession of £1,000,000 worth of copper ore ready for the smelter, whenever the company may decide on such a plant.

In South Australia the most interesting experiment of all is being conducted. This is boring for oil in the south-eastern part of the State. The enterprise is being carried out both by a local company and by an American expert, whose backers in the United States have provided the capital. Dr. Basedon des-

SYDNEY.

Copper.—Australia with 46,500 tons as its quota to the world's supply of copper in 1913, ranges fifth in importance among more than twenty other countries. Producing as it does only 4½% of the world's production, any diminution of output due to the war is but a small proportion as compared with the grand total. To the mining classes of this Commonwealth, where there are such kindly conditions



cribes the area as consisting of gently folded Tertiary beds. He says: "As regards sufficiency of organic matter from which the oil can be formed being contained in the geological formations considered, there need be little doubt entertained. We know that the Tertiary system is remarkably rich in fossils and further contains extensive beds of lignite." Accordingly, he recommends deep boring. As a set-off to this opinion, the State Geologists will not endorse Dr. Basedon's recommendation. Bores will furnish the evidence as to who is right.

for labour, the necessary curtailment of operations comes as a severe blow. It not only affects the companies themselves but all those dependent on the copper industry. And it is after all, on a smaller scale, the experience of the mining industry all over the globe at this time.

Cobar must of necessity be a problem for the future, its difficulties not being connected with the industrial upheaval. Before it can produce again, the mine will have to be put in the hands of a mining engineer capable of getting the workings into minerlike condition.

The Wallaroo and Moonta Mining & Smelting Co., one of the most important industries of South Australia, was enabled to continue operations by the kind offices of the State Government, which has become responsible for the financing of its metal output. The employees agreed to the company withholding 10% of the wages until realization of the copper was made. The dropping of the price of copper since the above arrangement was made, it is now announced, means a serious loss to the company; hence the men have been asked to accept a 20% reduction from the scale of wages now ruling. Wallaroo is now a deep mine (over 2300 ft.) and mining is expensive on account of swelling ground and the maintenance of workings necessary for haulage. The cost of producing copper is comparatively high and there is no material assistance accruing from precious metal contents.

It has been said that the remodelled Wallaroo is a queer mixture of the antiquated and the modern. This is hardly a true rendering of the situation, except perhaps as regards accounts and the technical information given to the shareholders. This is a pity, but is what might be expected from an old conservative company insensitive to criticism. The technical side of Wallaroo is now up to date, both on the mining and metallurgical side, and a recent visit to the works left only one regret, and that was that the details of such good work should not be given more freely to mining engineers and those interested in copper mining.

Mount Lyell has now regained its producing power, and apparently intends to turn out 600 tons of copper per month. To help matters along, the North Lyell developments are promising, for approximately 6% ore is of material advantage in increasing the yield of the furnaces. While in June and July the yield from the mixed ore was under 2'2%, this has improved during August and September to over 2'3%, an important increase when treating over 26,000 tons per month.

Queensland may suffer most from our decline to barbarism. Mount Elliott was practically out of the race, having its own difficulties in the failing of the mine to develop more profitable smelting ore. The Hampden Cloncurry has made an arrangement with its employees to accept half of their wages in cash and the balance when its blister copper is sold. This company has also made the necessary arrangements to enable it to store its copper output for the present. No reduction in operations is expected, so that 1000 employees

will be maintained as before. The production of the Hampden-Cloncurry group will be roughly 600 tons per month, and the comparatively good results obtained from the development of the Duchess mine will enable this company to produce for some time to come, notwithstanding the disappointment in finding fresh ore in the Hampden mine.

The recent slump in Mount Morgan shares has been a surprise to many, but perhaps that is due to the fact that no other company's affairs are more commented upon. The gold contents of this company's blister, which roughly averages over 8500 oz. per month, is a great fillip when base metals are degenerate, and no doubt this mine will have less difficulty than any other copper mine in paying its way. Presumably, the output will be between 600 and 700 tons of pure copper per month, which will be refined at the works of the Electrolytic Refining & Smelting Co. at Port Kembla, where also the Mount Lyell copper is treated. The Port Kembla works treats the blister copper of these two mines, that was formerly sent to the United States to be refined.

The small concentration unit has recently been handling about 180 tons of crude ore per day, producing a smelting product assaying over 7½% copper and 15 dwt. gold per ton. Apparently this is an attractive result, but the reports do not give such particulars of recovery as are necessary to an accurate survey of the position. It would indeed be fortunate for the company if wet concentration and flotation were going to solve the metallurgical problems. Some metallurgists think differently, and the scant information furnished by reports tends to make the investigator critical. The smelting mixture has recently fallen in grade and become more silicious. Two years ago it was stated that the silicious ore, which was then being chlorinated, could be more cheaply smelted, but on this score recent reports are not in agreement. The big smelting plant, now practically complete, has been an expensive affair, and may not be quite justified by a calm survey of the ore reserve. If the bulk of the ore resulting from future developments is to be of the low-grade silicious type, it is hard to understand how the large blast-furnaces designed for pyrite smelting are going to be equally useful for smelting finely divided concentrate.

Summing up the copper mining position in Australia, the present output is at the rate of about 31,000 tons per annum and the probable decline of 15,000 tons is nearly one third of the normal production.

TORONTO.

Cobalt is seriously affected by the war and the low price of silver, which has caused the reduction of dividends by several companies. The Coniagas has cut off its quarterly 3% bonus, the Seneca Superior reduced its latest dividend from $12\frac{1}{2}$ to 10%, and the Crown Reserve announces that the dividend rate of 24% per annum can no longer be maintained, though the extent of the reduction has not yet been determined. In the last case the adverse conditions created by the war (including the stoppage of payment for two carloads of high-grade ore shipped to Saxony) are supplemented by the difficulties encountered in exploration work on the bed of the Kerr Lake, from which the water has been drained. There remains a considerable depth of mud, which cannot be cleared away until spring. In the meantime the company is pursuing a conservative policy by husbanding its surplus for the development of its subsidiary holdings and depending upon its low-grade output of about 2600 tons per month to pay expenses and leave a fair margin of profit. The Crown reserve is operating the Silver Leaf property under lease, and has recently cut a small vein of high-grade ore on the 75-ft. level. Bullion shipments have almost ceased. The Nipissing, by far the largest producer, is storing its bullion, and others are generally pursuing the same policy. There is an increasing disposition on the part of mine-owners not to market any more silver than is necessary to meet current outlays. Some good discoveries have been lately made by the Nipissing as the result of hydraulic operations. Four veins of high-grade, one of which is of considerable width, have been found. Over 300 ft. of driving has been done on the main vein of shaft 64 at the 900-ft. level, but silver contents are low. A winze will be sunk to the 1000-ft. level.

The first result of the new policy of extensive exploration adopted by the La Rose Consolidated is the finding of a small high-grade vein, assaying from 2500 to 3000 oz., in trenching on the La Rose Extension. It has been traced for 50 ft. The ore at the Princess has all been taken out and the mine closed-down. The new high-grade vein at the Savage property found at the 140-ft. level has been proved to a depth of 55 ft. and maintains its richness, the average value to present depth being estimated at over 7000 oz. per ton over a width of 4 inches. After being closed-down for over three months the Temiskaming mill has been started again with 20

stamps, there being between 4000 and 5000 tons of ore on hand. Ten more stamps will shortly be in operation. On the 7500-ft. level an exceptionally rich shoot of ore has been opened up for 45 ft. The Right of Way, which had not made any returns to shareholders for 3 years, has declared a dividend of 1%. This is believed to be a final payment, as the property is about exhausted.



MAP SHOWING MINING DISTRICTS OF ONTARIO.

Porcupine.—While anything resembling a boom is out of the question so long as the war continues, there is a marked increase of activity and interest in this district. The leading companies are steadily increasing their capacity, and the output bids fair to be greatly increased in the near future. While not many new properties are being taken up, it is pointed out that the attitude of the holders of undeveloped claims and the unreasonably high figures at which prospects are held, acts as a deterrent to investment, especially at a time like the present when the general public has neither the means nor the inclination to take the risk in mining ventures, and money is only obtainable from capitalists. Unless

more reasonable terms than have been obtainable in the past can be secured by those prepared to make large, but discriminating, investments the magnificent future predicted for the gold-mining industry of Porcupine will be indefinitely postponed. The Dome report for October shows an output of \$95,880 from the treatment of 22,500 tons of ore averaging \$4.70. The working cost was \$2.64 per ton. A complete re-valuation of the mine is now being undertaken by diamond-drilling with the object of ascertaining whether a further extension of the mill would be warranted. Six diamond-drills have been installed to explore the whole known orebody, 1700 long by 400 ft. wide, which will be drilled in 100-ft. blocks. The main vein of the Hollinger has been cut in the winze at the 800-ft. level, where it maintains the width and richness of the higher levels. Two power-units are running, and a third compressor with a capacity of 50 drills is being installed. The staff has recently been considerably increased. The cross-cut to connect the new main shaft with the Miller-Middleton has been begun and will be run 800 ft. from the present workings to the old Miller-Middleton shaft. The total shipments of the McIntyre for the past eight months amount to \$395,015. The production for October was \$64,732 from the treatment of 7510 tons of ore of the average assay of \$8.84 per ton. The Dome Lake mill is now running regularly, treating about 40 tons of ore per day. So far the runs have been mainly for sampling purposes. No definite idea can be obtained of the mill-grade until improvements now in progress for sorting ore have been completed. Plans are in preparation for a new mill of 150-ton capacity at the Schumacher for the treatment of ore by cyanidation. The Foley-O'Brien is being reopened with A. C. Bailey, formerly with the Cobalt Townsite, as manager. A new boiler and hoist have been erected and the shaft is being unwatered. Development at the Tough-Oakes, at Kirkland Lake, has reached the 300-ft. level, where the veins are reported to be even richer than on the surface.

Sesekinikia.—Several large transactions were in negotiation for claims in this district when the war broke out, and all deals were called off. Recently the Murray, Mogridge, and Powell group comprising eight locations on the east side of Wolf lake, Maisonville township, have been purchased by Dr. J. M. Bell, representing the Huronian Belt Mining Co., in which British capital is largely inter-

ested. The price is stated at \$150,000. The Beederman claims, eight miles west of Sesekinikia, where a wide vein of high-grade ore has been discovered, will be extensively developed by Buffalo capitalists. A diamond-drilling outfit has been received.

Nickel Export.—At the close of last month the Canadian government issued an Order-in-Council prohibiting the export of nickel together with other contraband of war to Germany, Austria, and some other European countries. This action was taken largely in view of an agitation, which had been for some time in progress, to prevent Germany from obtaining supplies of this metal for armament purposes. But it entirely fails to meet the case so far as nickel is concerned. There has never been any direct exportation of nickel from Canada. The nickel produced by the Mond company goes in the form of matte to Swansea. The other Sudbury product is shipped in the form of nickel-copper matte to the refinery of the International Nickel Co. in New Jersey, and Canada has no control over the disposal of the refined metal that has largely gone to supply the German demand. It is stated, and generally credited, that the Krupps are extensively interested in the International Nickel Co., and the Government is being urged to prevent all exportation of nickel in any form outside of the British Empire. Many leading newspapers have taken up the matter in uncompromising language, and it will certainly be discussed at the next session of Parliament unless action is taken earlier.

JOHANNESBURG.

Gold Production.—You will ere this have been informed by cable that despite the fact that a state of war as well as of rebellion exists in the Transvaal the gold output for the Rand was higher last month than for any corresponding period for the preceding 15 months, dating back to the July riots of last year. This, it must be conceded, is a satisfactory achievement for the Rand mining industry and reflects credit on all concerned. It used to be quite a usual thing during a revolution in the republics of South America for the combatants to retire up-country to fight out their differences, while the mines and other industries were carried on as usual by foreigners; but it is unusual to witness business being carried on as usual in a country where a state of both war and rebellion exists side by side. The approaching end of the year and the comparatively satisfactory outputs of gold being obtained by the Rand mines, naturally

causes one to try and gauge what the probable output for 1914 may be. Last year for the first time showed a marked shrinkage, and many people thought that the Rand had at last attained its height of productivity. The output for 1914 has therefore been watched with more than usual interest, but, as far as can be seen at present, even should a normal condition of affairs prevail for the rest of the year, the gold output is sure to show a marked decrease on that of 1913, no matter how unsatisfactory at the time the 1913 output was considered to be. Roughly, I estimate the probable output of the Transvaal at £35,694,700, as compared with £37,358,040 for 1913. The principal cause of this decline will be found in the growing difficulty in raising adequate working capital for the opening and equipping of the extensive deep and low-grade areas of the Far East Rand to such an extent as to compensate for the exhaustion of the richer outcrop mines.

Earth-Tremors.—For some time past Johannesburg has been free from these disturbances, but early in the month of November there was one of the worst yet experienced. The shock was similar to those experienced in volcanic countries, but local authorities attribute these occurrences to subsidences in the mines rather than to earthquake shocks. Be this as it may, the management of the Village Main Deep sent a cable to London to the effect that owing to an earth-tremor the shaft-pillar and about 150 ft. of vertical below No. 6 level No. 2 shaft was crushed, and No. 9 and 10 stations had collapsed. It is noteworthy that before these deep mining subsidences took place on the Rand, such earth-tremors were never noticed, but during these last four years they have been somewhat common; while it is impossible to trace them to a volcanic origin, as the nearest active known volcano is as far distant from the Rand today as it was before the Rand was discovered. It would be interesting to hear the experiences of any of your readers who have mined in earthquake countries; that of the writer, who has mined somewhat extensively in South American countries, where earthquakes were common, and the hanging and foot-walls were of the worst description, needing close timbering, being to the effect that where the mines were of moderate depth, earthquake shocks produced little or no effect in the underground workings. On the Rand these earth-tremors are absolutely impossible to distinguish from earthquake shocks, but they are generally contemporaneous with an

extensive mine-subsidence, and are most noticeable along an old fault-line of weakness running through Johannesburg. In short, what is really wanted is to know whether these earth-tremors are the result or the cause of extensive mine-subsidences. It is authoritatively stated that at the Village Main Reef, the sand-filled areas saved the underground workings from what would otherwise have been serious consequences, which goes to show that in deep mining on the Rand sand-filling is becoming essential, and ought not to be confined to those areas apparently needing surface support, such as are, for instance, covered by railways and buildings.

Effects of War.—As far as the immediate future of the mining industry is concerned, gold-mining seems likely to feel the effects of the war less than base-metal mining, and certainly less than diamond-mining, which, owing to the falling away of the demand for gems, has practically ceased to exist. The importance of gold mining will naturally cause every effort to be made to keep the industry on its feet and everything possible in this direction is naturally being done both by the Government and those in control of the mines. There will be no difficulty in obtaining the various stores and chemicals not produced in South Africa, such as zinc, cyanide, mercury, and oils. For instance, zinc must now be obtained from America. It is interesting to note, however, that attempts are being made to produce zinc from the Blane-Witkop mines near Zeerust in the Western Transvaal, where some rich deposits of zinc ore have been opened up by the Transvaal Consolidated Land & Exploration Company, which has engaged J. W. McKim, from Salt Lake City, to assume the management. There is not much likelihood of difficulty arising with regard to the future supplies of cyanide, which is now expected to come largely from Scotland instead of Germany, while mercury can still be obtained from Spain and Italy. As for explosives, these are principally made in the Union from imported raw materials, of which it is understood there are ample supplies on hand. When we come to deal with base-metal and mineral mining, there is not the same freedom from interference. Take, for instance, coal mining. When the war first broke out large quantities of coal were hurried to the coast ports in anticipation of a brisk demand for bunkering purposes, the coal mines were busily employed, but all that has now changed through diversion of shipping, and as a result the collieries throughout South Africa are now irregu-

larly employed, through lack of demand for bunkering purposes and want of railway trucks for transport. The few tin and copper mines in South Africa are also working on a much reduced scale owing to the difficulty experienced in shipping the output, but, on the whole, the diamond industry has been hardest hit by the war. Although open rebellion is being waged at a distance of fifty miles north, south, and west of the Rand, there does not seem much prospect at the time of writing of the revolution encroaching upon the Rand gold mines, where there are sufficient employees to supply all the protection needed. As for the revolution itself, it has been pretty well wiped out in the Transvaal and apparently only needs strong handling to be extinguished in the Orange Free State.

Mine Ventilation.—In reply to a discussion on a paper on the above subject read before the South African Institution of Engineers, the author, W. Pile, severely criticized the condition of mine ventilation on the Rand, and his remarks have led to a lively discussion. An author, in replying to a discussion, has usually the advantage of the last word, but in this case, the subject has been reopened by the reading of another paper in reply, by H. Stuart Martin. There was a good deal of truth in what Mr. Pile said about the unsatisfactory condition of ventilation, but during the last five years a marked improvement has taken place. Before that time, artificial ventilation was practically unknown, and the mines were reaching a depth at which some method of ventilation by artificial means was becoming absolutely necessary, in fact at the Village Deep a crisis was fast approaching. It was at the East Rand Proprietary Mines that artificial ventilation was first introduced on the Rand, and its success there was so marked, that with the phthisis fiend rampant, other deep-level mines found it absolutely necessary to introduce the use of fans. Today practically all the deep-level mines are ventilated by artificial means, but in numerous instances the amount of air circulating in a mine is no sure criterion that the mine is well ventilated. The difficulty on the Rand is to prevent the air currents taking the shortest circuit to the surface or upcast shaft through the exhausted stopes, leaving the working places practically devoid of fresh air. This difficulty is not easily surmounted on the Rand without the exercise of much trouble and expense, the need for which has not been yet fully recognized. Mr. Pile was severe on the method adopted at the

Village Deep of placing the fan underground, and exhausting the return vitiated air from the Village Deep workings into the Village Main mine. Mr. Stuart Martin, the designer of the Village Deep scheme, justifies the placing of the fan between the two mines underground, by reason of the lack of shaft-area to supply the quantity of intake fresh air for the Village Deep workings. In metalliferous mines, where there is no risk of firedamp explosion, the objection to placing the fan underground does not exist. It must not be forgotten, however, that the primary object of mine ventilation is to circulate fresh, not vitiated, air through the working places, whether such mine is a deep level or an outcrop mine, and any system of ventilation that fails to attain this object, as undoubtedly is the case at the Village Main Reef, must necessarily be regarded as unsatisfactory. Fortunately on the Rand, the advantages of a circular shaft over a rectangular one, as the main artery for ventilation purposes for a deep mine, are becoming recognized, as may be instanced at New Modderfontein, City Deep, and Crown Mines.

The Daggafontein Strike.—The recent strike of the Main Reef series at Daggafontein, in the Far East Rand, does not appear to have attracted the attention it deserves. The shaft at Daggafontein is about four miles due east of Springs, and is the most easterly point on the Rand where the Main Reef has been exposed and proved by shaft-sinking. Many bore-holes have been put down to the Main Reef series in this part of the Rand, but bore-holes are notoriously unreliable for sampling, and can be taken only as an indication of depth and width of ore; and on this account the intersection of the banket by the Daggafontein shaft at 3580 ft. vertically is an event of importance. The assay of a sample taken all round the shaft averaged 8 dwt. over a stoping-width of 40 inches, as compared with 6 dwt. obtained over the same width at the neighbouring mines farther west now in the course of development. It adds to the interest of the event to be able to report that, by further driving on the ore, even better assays than those indicated in the shaft have been obtained; in fact, the banket in places carries visible gold. In the shaft the width of ore was only six inches, thus showing that already the banket at this point has begun to show the characteristics of the Nigel Reef, the nearest point in the Heidelberg district where successful gold mining has been conducted for many years.



DISCUSSION

Prospecting and the War.

The Editor :

Sir—The articles dealing with the various phases of the war in the Magazine for October will be particularly welcome to those out of touch with what has been said and written on the subject, as also to those newly returned from out-of-the-way places. So far the two greatest surprises of the war have been the discovery of the true character of German 'kultur' and of the enormous power and resources of Russia. To some of us, perhaps, the exposure of German 'kultur' has not been so great a surprise as to others, though few, if any, expected that even educated Germans could be such unspeakable brutes as they have undoubtedly proved themselves to be—plodders in all else, they are plodders even in their fiendish cruelty. No intelligent travelled man forgets that there are some good Germans, neither does he forget that in the preparation for this war the German government has been supported by the mass of the people, including the intelligent classes, and that preparations have gone on for years.

Before the war mining men were beginning to look toward the great Russian empire as the coming country for speculative mining work, and the recent violent vulgar abuse of Russia by Germany will probably have one good effect in that it will direct further attention to that promising country. Among the many who will be inquiring for further information about Russia and the Russians there will surely be some business men who will realize the enormous possibilities, from a mining point of view, of the huge territory controlled by Russia.

The Germans have lately told the world at large that the Russians are barbarians. How truly laughable to speak thus of the country which has produced Dostoevsky, Mendeleeff, Metchnikoff, Tolstoy, Pushkin, Vereschagin, and the like. As a matter of fact the people one ordinarily meets in Russia are decidedly well informed intelligent people, and the *mujik* is often much like our own peasant. Many still take their ideas of Russia from sensational

novels or from rabid radicals who have never lived in the country, and would be greatly surprised to hear that, in the opinion of people who have lived for many years in the country, Russia is one of the most democratic countries in the world. The Russians are a most kind and hospitable people. Politics in detail does not interest mining men except in their own countries, still it is necessary to know that the general policy of Russia is a forward policy.

In the past Russia has been much occupied in repelling invasion from the East—this is speaking generally and not referring to the war with Japan, which, after all, was only a later incident—and in consequence the country generally has not been developed to the same extent as other more Western countries. But for what Russia has done in the past in preventing Europe from being overrun by savage tribes, no less than for the heroic and brilliant help she is now giving in the suppression of 'kultur,' the rest of the civilized world has every reason to be eternally thankful.

Russia is backward in some matters, notably in agriculture and sanitation. According to Gregor Alexinsky the average yield of wheat per acre in Russia is only one-fourth of that in England, and this is not surprising seeing that in addition to insufficient cultivation in many places no artificial fertilizer is applied to the soil, the whole of the farmyard manure being dried for use as fuel in winter. I have seen it even used for making dams. According to the above authority many peasant people in Russia are underfed, so that infant mortality and mortality from phthisis are very high. By improving agricultural methods much good should result; the people would be better fed, the children more healthy, and there would be more money for improving the village houses and mode of living; incidentally, mining would be benefited, owing to its close connection with agriculture through the iron industry, which provides tools and machinery; also by reason of more artificial fertilizers being required.

Russia is in need of money for many purposes. Some of this money must be provided by the development of her own natural re-

sources, and the fact that interests mining men is that great as is the known mineral wealth of the Russian empire, its possibilities, even probabilities, in this respect are infinite.

There is now, and in the immediate future, a splendid market for British goods in Russia, and it is to be hoped that John Bull will "hear that knock," so graphically illustrated on the cover of your last Magazine, as applied to Russia, for the closer and greater the ordinary trade associations of the two countries the greater the probabilities of British capital being put into Russian mining ventures, and the brighter the prospects for prospecting engineers whose lot of late years has been more than dull.

STEPHEN J. LETT.

London, November 2.

Ore.

The Editor:

Sir—I think many of us must agree with Mr. Holloway in saying that "definitions when too strict are often more of a hindrance than a help," and although I regard your definition of what constitutes an 'ore' as, on the whole, better than any of the suggested alternatives, it is still both too wide in one direction and too narrow in another to cover all the cases that will continue to be called 'ore' by the average mining engineer, whether or not they conform to your own or to any other definition.

If you are correct in saying that pyrite is not an 'ore' of sulphur, the question at once arises what is it that a number of the mines in this province of Huelva are engaged in mining. Rio Tinto, Tharsis, the mines of the United Alkali Company, and a few others can be still considered as copper mines according to one part of your definition, since copper is extracted from the 'ore' they yield. On the other hand, without the value they realize from the sulphur, with the single exception of Rio Tinto, no one of them could produce copper at a profit. But what is to be said of the large number of smaller mines such as Peña del Hierro, Perrunal, La Joya, Lomero, Poyatos, and many others, the material (iron pyrite) mined in which yields no metal that can be "extracted to economic advantage."

Although the residue from sulphuric acid works under the name of 'purple ore' is generally utilized for the production of iron, the material in its natural state as mined can hardly be called an ore of iron; as such no one in the iron trade would look at it. Evidently, then, according to your definition,

the stuff is not 'ore' at all, and therefore the deposits themselves cannot be 'ore' deposits. Presumably too the holes in the ground from which the stuff comes should not be called 'mines'; and perhaps even the engineers in charge of the work should not be called mining engineers, but quarrymen. As for the ore deposits, their case is indeed sad. Carrying, as they often do, in their upper zones 2 or 3% of copper, they commence as ore deposits of quite unimpeachable respectability. In depth, however, while retaining their size, shape and other physical characteristics, and without any change either in appearance or in mineralogical or chemical composition, other than the gradual reduction in the proportion of copper which is so subtle as to be often recognizable only by the chemist, the deposit degenerates till a point is reached at which the commercial extraction of copper at a profit is no longer possible. The deposit is now an ore deposit no longer; beyond, say, the 20th floor it has no longer any right to figure in treatises on the subject; the mine no longer yields 'ore' but mineral, and "the ore having been exhausted" the only logical course to follow would be to close-down the mine and liquidate the company, in spite of the fact that owing to the upward tendency of the sulphur market it may happen to be now a more profitable concern than in the days when it produced "copper ore" from the upper workings.

Surely this is a *reductio ad absurdum*; the term 'sulphur ore' commonly used in this province of Huelva must be held to be under the circumstances admissible, and the mines of Perrunal and La Joya which produce a pyrite with 49 to 50% sulphur and not enough copper to pay for extraction must be conceded the same right to the use of the terms 'ore' and 'ore deposits' as their neighbours working deposits that are precisely similar in every respect save that their product contains on the average copper enough to "render its extraction economically advantageous."

And if this be granted, what about the case of the precisely similar masses of pyrite, quite important in point of size, the material of which happens to be a trifle more impure, containing finely disseminated silicates, blende, magnetite, or other impurities, in such proportion that the percentage of sulphur is reduced to 40 or 42%, with the result that under present conditions such masses cannot be worked at a profit, although it is tolerably certain that in the course of 10 or 15 years the demand for sulphur will increase to such an extent as to permit of their profitable working?

Will these masses of mineral then yield 'ore' and become 'ore deposits'? If so, what are we to call them now? If you, Sir, were preparing what you designed to be an exhaustive treatise on the ore deposits of the province of Huelva, would you be so consistent as to leave them out? If so, the omission would very much detract from the value of your treatise. The fact is that definitions are good servants but bad masters; in my opinion no definition of ore can be drawn that will cover all the cases and omit no exception. Upon the whole, however, your definition of 'ore' as "rock from which metal can be extracted to economic advantage" appears to cover the ground better than any other I have seen, provided that we qualify the "economic advantage" by adding the word "probable," and make a mental reservation in favour of sulphur ore.

H. F. COLLINS.

Valdelamusa, October 30.

[Evidently the definition of ore is a provocative subject. In the case of the mines in the Huelva district, the sulphur in the copper ore is a by-product; as sulphuric acid is a by-product, for example, in the metallurgical treatment of the sulphide ore of zinc. It is as easy, and more accurate, to speak of iron pyrite, mined for sulphur, as 'mineral.' Because careless or non-technical persons like to speak of quartz containing traces of gold as 'ore,' we see no reason for falling into their slipshod ways. It is not too much to ask technical persons to forbear from using terms indiscriminately, so as to avoid misleading those to whom they proffer information. As to 'purple ore': Yes; this by-product does not indicate that the crude material came from a mine of iron ore; the deposit was probably a deposit of copper ore. It was an 'ore deposit,' but not of iron, because it was not exploited mainly for the purpose of gaining economic advantage from the sale of iron, but of copper. Had the presence of iron in the deposit been the predominant economic factor, then it would have been a deposit of iron ore. Any definition can be twisted into a knot by playing with words. When exceptions arise, it is not necessary to make a new definition; it suffices to state the factors that make the case exceptional. As to whether the holes in the ground from which the 'purple ore' is derived should be called 'mines': that does not stultify the definition of 'ore.' Coal comes from holes in the ground, but coal is not 'ore.' As for the deposit of copper ore

that loses its copper content in depth and becomes more valuable as a source of sulphur, we cannot see that it is a great task to recognize the change of economic conditions by calling one copper 'ore' and the other sulphide 'mineral.' We are not at all sure that it is a *reductio ad absurdum*; it is a reduction to basic facts. The absurdity arises from the expectation that a single word can perform the function of an entire paragraph. When abnormal conditions arise, it is necessary to expend a few extra words in description. We find it natural to speak of pyrite sold for its sulphur content, of pyrite sold for its copper content, and of washed material from which the copper has been extracted at the mine. The Perrunal and La Joya pyrite mines are as precisely similar to their neighbours, which yield copper ore, as a lode consisting of quartz with traces of gold is to another consisting of quartz carrying an ounce of gold per ton—precisely similar to a mineralogist, a geologist, or a gardener, but two entirely different things to a miner. One probably will yield 'ore'; the other, silica for bottle-making or rockeries in a garden. 'Ore' connotes economic conditions vital to industry, namely, the conditions favourable to profitable exploitation. To divorce the term from economics is to ignore the prime purpose of mining and the one basic reason for the search and exploitation of mineral aggregates. Finally, if we were preparing an "exhaustive treatise on the ore deposits of the province of Huelva," we should not be confounded by the existence of masses of mineral containing substances of varying market-value. We should explain the circumstances and add largely to the usefulness of the treatise by affording detailed information, for which we should turn, in the first place, to Mr. H. F. Collins. We should not dismiss large masses of pyrite by dubbing some of them 'copper ore,' and others 'sulphur mineral.' Recognizing the fact that economic conditions change, and more particularly the market-prices of sundry substances used in the arts, we should explain the effect of such changes upon the exploitation of the deposits in the province of Huelva.—EDITOR.]

Long and Short Tons.

The Editor :

Sir—The correspondent from New Zealand who writes on this subject in your October issue has my entire sympathy.

The English statute ton happens to be just 1'6% heavier than the metric ton; so close therefore as to render comparisons easy and

convenient. It is by the English ton that copper, lead, spelter, and all other common metals are sold, at all events in Europe, which is where they chiefly are sold and consumed, produced though they be in America. Your statement that "the reports of mining companies nowadays use the short ton" is doubtless correct as regards gold mines, and other mines under the control of American companies or American managers. It is quite incorrect as regards European mining. No mining company in Spain, for instance, uses, ever has used, or in all probability ever will use the 2000 lb. ton; they keep their accounts in metric tons and sell their products by the statute ton which, as before mentioned, are sufficiently close to involve only a small correction in converting one to the other, and for purposes of comparing figures of costs, etc., the two 'tons' may be considered as practically identical.

H. F. COLLINS.

Valdelamusa, October 28.

The Kent Coal-field.

The Editor:

Sir—I have read with interest Mr. Lichtenberg's article on the Kent coal-field. Mr. Lichtenberg is to be congratulated on his good plain statement of affairs, and if more information from a commercial standpoint could be added a very fair idea of the position in Kent would be obtained. For the last 20 years mainly geological information has been given, but as the coal-field is not much use to anybody if it cannot show profits, mainly geological information gets a little tiring. Now it is a well known fact that older coal-fields in England exploiting a better class coal than the Kent coal are merely existing on a narrow margin of profit, and it is a pertinent inquiry to ask what the Dover coal-field has in its favour that warrants the large amount of capital that is being spent on it. The depths are great, the coal seams not so hard and clean as other British coals, and inferior in quality generally. Large quantities of water have to be combated, and the cost of timbering will be high.

As to the position of the coal-field being a factor in its favour, this remains to be proved. The Welsh and North Country coal-fields are so well situated for shipping and transport facilities that I don't see how the Dover coal-field can oust or compete with them in any of their markets, even supposing the coal is as good or can be worked as cheaply. Perhaps someone more enlightened as to the particular

circumstances can give information on these important points.

ALGERNON NOBLE.

Northumberland, December 5.

Supposed Tin in Springs.—In *Comptes Rendus* for 1891, Stanislas Meunier described mineral deposits of opal type supposed to have been formed in hot springs in Selangor and Malacca, in the Malay peninsula, these deposits being reported to contain as much as 0.5% of tin oxide. At the suggestion of J. B. Scrivenor, the Government Geologist of the Federated Malay States, visits were paid by W. R. Jones to several hot springs. As the names mentioned by Mr. Meunier are of frequent occurrence in the Malay States, it was deemed advisable to go to all places bearing the name that have hot springs in the neighbourhood. The object was to investigate Mr. Meunier's statements, for if proved, they indicated the formation of cassiterite from ascending hot waters. Mr. Jones' results are given in the *Geological Magazine* for December. He shows that at a number of places hot springs, in which the water averages 50 to 55° C., are found not far from granite outcrops and all of them smelling of sulphuretted hydrogen. The granite as a rule contains small amounts of cassiterite. No trace of tin could be found in the waters. Minerals similar to that analysed by Mr. Meunier were found on adjacent weathered tin-bearing outcrops. It is also noted that springs occasionally bring fragments of cassiterite upward from the limestone, the water having dissolved the rock and leaving the cassiterite free. No evidence whatever was found by Mr. Jones of any cassiterite dissolved in the ascending waters or of any mineral that could possibly have been deposited from them.

The Director of the United States Mint, Mr. George E. Roberts, has resigned in order to accept the presidency of the National City Bank. Mr. Roberts was the editor of a country paper in Iowa, when, in 1896, he issued a book exposing the silver fallacies of W. J. Bryan, now Secretary of State. President McKinley appointed him head of the Mint in 1897, and he has held the position continuously since, except for a short period during which he served the Commercial National Bank of Chicago. The bank of which he is now president has recently established branches in South America, and is looking for a large business following the opening of the Panama Canal.

THE BERENGUELA TIN DISTRICT

A Group of Tin Mines in Northern Bolivia ; the Geology, Production, Concentration Methods, and Economic Conditions.

By HAROLD ALLMAN LEWIS

Introductory.—This mining district is situated roughly half-way between the towns of Oruro and Cochabamba, or twenty leagues east of Oruro, in Bolivia. A branch railway is being constructed between these two towns, and the rail-head is now at Arque, slightly over half-way to Cochabamba. The nearest point to the mines is Colcha, a village at the foot of the Berenguela mountain, 2500 to 3000

On the Oruro plateau, at an elevation of 12,200 ft., no tree will grow, while in the valley of Arque at over 9000 ft. lemons and peaches are produced in abundance. The facts that the Berenguela region is closer to agricultural districts and that the climate is less rigorous than in any other Bolivian mining district, are of economic importance as influencing the scale of wages, these being less than in any other mining camp in the country. The corollary is that, other things being equal,



MAP OF BOLIVIA, SHOWING POSITION OF BERENGUELA MINING DISTRICT.



ft. below the mines and about a league from most of them. Once the *altiplanicie* or plain of Oruro is left behind, the country becomes rugged and precipitous. The building of the railway on the descent from the summit of the hills (nearly 15,000 ft. above sea-level) bounding the Oruro plateau on the east down as far as the town of Arque may be classed as one of the engineering feats of the world. The streams crossed are among those that eventually combine to form the Amazon, discharging into the Atlantic ocean after traversing a distance of 2000 miles.

here should be profitably mined ore of lower grade than elsewhere in Bolivia. Nature apparently has preserved the balance by making the grade of ore average between 2 and 3% tin, which is appreciably lower than the average of the famous mines of Uncia and Llallagua near Huanuni, and other localities.

Geology.—The Berenguela mountain is situated in the line of the Cordillera Real or eastern range of the Andes. The main direction of this range is northwest. Parallel with this range and west of it we have the Cordillera Occidental, with many volcanoes, the probability being that the upheaval of the

Cordillera Real caused a line of weakness here, thus being indirectly the cause also of the western range being formed subsequently.

In a country such as Bolivia, to which as yet geologists have given but scant attention, it is necessary to deal in generalities. As regards Berenguela mountain, it is formed of alternating beds of shale separated by quartzite and sandstone. In places, in order to distinguish between quartzite and sandstone, it would be necessary to make a microscopic examination. Some of the slate on the west side of the mountain occasionally yields round balls, which, on fracturing, disclose impressions of bivalves and other shells. Sufficient distinctive fossils have not yet been found to enable the geologic age of these rocks to be determined. Fossil impressions are common

As a result, deeper strata are on view in the mountain than elsewhere in the district.

On the east side of the mountain the crumpling has been still more severe and the strata are found standing on end, the probability being that the valley on the east was formed by the old syncline. The lodes on this side mostly strike west and northwest, dipping east. The country throughout is much disturbed, and beds are seen with every imaginable dip; but the predominating strike is roughly northwest.

An interesting feature of the district is that nowhere is there visible any igneous rock and therefore at present the nature of the underlying magma, which must have been the origin of the cassiterite and other mineral filling of the lodes, is matter for conjecture. At Quir-



IDEAL GEOLOGICAL SECTION OF THE BERENGUELA DISTRICT.

on both sides of Berenguela mountain. On the west side of the mountain these alternating beds have been tilted, and in the main have now a strike northwest, dipping 30° northeast. The principal lodes on this side cut the formation approximately at right angles, having a strike northeast and a dip about 45° northwest. Two productive lodes, however, having roughly the same strike, dip in the opposite direction. In some of the surrounding districts the shales and quartzites are overlain by Red Sandstone, but such does not appear to be the case at Berenguela. The range on the west side of the valley is capped by this rock and all the beds have approximately the same strike as those on the mountain, but they dip in the opposite direction. From this the inference can be drawn that here we have a region that has undergone great lateral pressure, gradually being thrust upward, thereby forming an anticline that has parted ultimately at the top, giving us what is now Berenguela valley. The pressure probably continued, thus forcing the mountain to a still higher altitude and so exposing the Red Sandstone in this part more fully to glacial erosion, thereby accounting for the fact that on this mountain the Red Sandstone is no longer in existence.

quiavi, five leagues southwest, there is a lava-flow. There is another lava-flow in the hills bounding the east side of the Oruro plain, but this is twice the distance from Berenguela. In the Arque valley, at the foot of the mountain and 4000 ft. below the summit, are found hot mineral springs of all temperatures up to boiling point. One of the railway-cuts not far distant had to penetrate a cliff composed of quartz cemented together with native sulphur, which occasioned considerable difficulty owing to the blasting materials having a tendency to explode before the fuse could be lighted, because of the air causing the sulphur to become hot. It should be mentioned that the cut was not attacked in small sections from above, but that tunnels were driven for the purpose of utilizing heavy charges. Two leagues farther down the valley and alongside the railway, are extensive deposits of pure gypsum.

Mineralogy.—Within the oxidized zone the vein-filling is chiefly limonite with broken and sometimes pulverized country-rock. The tin invariably occurs as cassiterite, even in the sulphide zone. In the oxidized zone I have rarely found minerals other than limonite, silica, and cassiterite. Occasionally the filling

is composed of quartz and small crystals of cassiterite. The concentrate from milling, however, discloses a little silver with sometimes traces of copper and antimony. In the sulphide zone are found iron pyrite chiefly,

nor have I ever found specimens of either galena or blende, although both of these are reported as being found on the east side of the mountain.

The cassiterite has a marked affinity for



THE BERENGUELA MILL.



THE TUCSUHUMA MINE AND MILL, WITH BERENGUELA MOUNTAIN IN RIGHT BACKGROUND.

rock-filling, and cassiterite, with occasionally stibnite and small amounts of chalcopryrite, these accounting for the traces of antimony and copper found in the concentrate. I have never seen any distinct ore of silver here;

one wall or other of the lode, especially for the hanging wall. Higher contents of cassiterite are almost invariably found where the lodes are in the sandstone or quartzite than when they are in the shale. Oxidation of the

vein-filling extends to greater depth in the quartzite than in the shale. These facts are of considerable economic importance, for the recognition of them should influence any scheme of development.

Seven years ago I noted similar conditions in the Tres Cruces district, and it is probable that they occur elsewhere in Bolivia. I have never seen either apatite or fluorite in the Berenguela district; that is to say, I have not found any mineral containing either phosphorus or fluorine. It would appear, therefore, that at the time of the deposition of the tin it might have been under such conditions as to have a great affinity for silicon. It is clear, at any rate, that from this particular district great masses of overlying rock have been removed, and it is, therefore, not too much to suppose that the tin was deposited under great pressure, and consequently under conditions of chemical combination totally different from those that obtain at normal temperatures and pressures as known to us.

No large defined crystals of cassiterite are found in this district. The cassiterite occurs either massive or in the finest powder, the latter predominantly.

Economic Geology.—The lode formation, as might be expected in sedimentary beds, shows considerable irregularity of outline and has been largely modified by the faults and fissures formed at the time of the lateral squeeze. On the other hand, I have seen no sign of faulting subsequent to the period of ore deposition. Naturally, at surface there are cases where the shifting of rock-masses has displaced the lodes, and I qualify the above remark to that extent.

A usual type of fissure is that which has the form of a Z, or a series of them. The angles, however, are more often obtuse than acute. When the plan of a lode shows this form it is a highly encouraging feature, as a large deposit of ore may be expected at the bends and for some distance therefrom. Indeed, lodes of this type are persistent to the lowest depth so far attained in the district; the depth, however, is not great yet. That these bends are simply the natural fissuring of sedimentary beds prior to the formation of the lodes is seen from the fact that the vein-filling shows no sign of torsion, and in many cases an inch of the finest white clay will be found on the foot-wall continuing undisturbed round the bend.

Another type of lode is that in which the section shows this Z form of fracturing on the hanging wall. Here we may look for trouble.

On first driving along the vein nothing out of the ordinary may be observed, and good assays may be obtained all the way; also, it may be that the first rise will for a considerable distance disclose apparently a fair quantity of ore. Now is the time *not* to write home and report a very promising prospect. Subsequent rises will encounter what appears, at first and until considerable work is done, to be a fault; or it may even be supposed that there is a series of faults. This effect is caused by the country-rock of the hanging-wall coming into the vein-fissure and overhanging at the usual dip of the country. The effect is exactly as if the lode had been suddenly and effectively cut-off. There will be often as much as eight metres between the true foot and hanging walls. In places these blocks have broken clean off the hanging wall, giving an additional vein to be explored. The lode is found to be erratic and unreliable, and further prospecting will disclose the fact that the only places in which profitable mineral is to be expected are immediately under these overhangs of the hanging wall. Under such conditions a large amount of prospecting in the end gives only a small amount of ore. If the first drift on such a lode is immediately under one of these overhangs, an erroneous inference is almost certain to be made as to future prospects. This type of formation would probably only be found in sedimentary beds.

The other lodes of the district are of normal type and call for no special comment. More movement, and therefore greater variation in fracturing, is apparent on the east side of the mountain than on the west.

Methods of Mining.—Operations, as is usual in Bolivia, consist of mining by adit. A cross-cut is run to the lode, which is then followed in the usual way and the necessary ore-passes made. Close to the mouth of the main adit a ropeway is installed to take the ore to the mill, which is generally placed at a much lower level. No suitable timber is available for mining purposes, the best being a crooked tree called *quehuña*, which yields a stick about 6 ft. long by 6 in. thick. It is a brittle wood and only useful in small drifts or for lagging. The importation of Oregon pine, costing B.0'31 per ft. of board measure, or, say, 5½ pence, in Oruro, is out of the question for ordinary underground purposes. I do use Oregon pine, however, for chute-boxes. If a drift or adit encounters bad ground, the only thing to do is to put in rough walling and arching. This is a costly job, as the stone

has to be specially selected, any stone with seams or flaws being useless, as it will split under pressure. Indeed, the best local stone will flake and finally split, and the walling and arching has then to be renewed. The quarry where the good stone is obtainable will probably be at some distance from the point at which the stone is required. The stone has to be quarried, roughly shaped, and brought to the point of application. Arch-stones cost on an average 15 c. or 2'7d. each, and wall-stones 12 c. or 2'1d., taking exchange at 18 pence per Boliviano.

A walling party consists of one *pongo* at B. 4 per shift, helped by two miners at B. 2'60; a shift of the party therefore costs B. 9'20. To wall and arch two metres of adit in average ground, with resulting dimensions in the clear of 1'80 m. high by 1'20 m. wide, the following is the cost:

| | |
|--------------------------------|---------|
| 5 Shifts of walling party..... | B.46'00 |
| 112 Wall-stones at 12 c..... | 13'44 |
| 50 Arch-stones at 15 c..... | 7'50 |

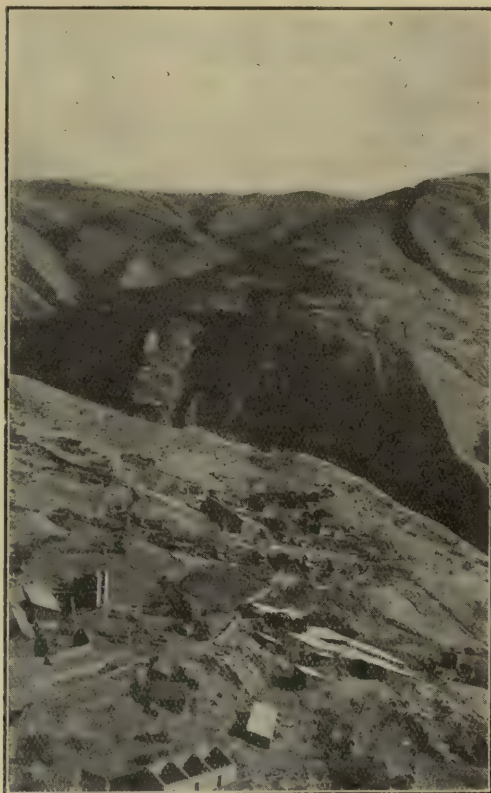
Total.....B. 66'94

Some allowance for tool-sharpening should also be made, and therefore if the price per metre is put at B 35 it will be a close approximation; that is, walling and arching, exclusive of driving, costs £2. 12s. 7d. per metre.

Where the veins are narrow and the country-rock sound, methods are normal and require no comment. Some of the principal lodes, however, are wide, at any rate in parts, and the hanging walls are bad. When such lodes dip at about 45°, the question of extracting the ore becomes matter for careful consideration. Any sort of effective timbering is out of the question.

The conditions obtaining in one actual case were the following: Above a certain level the ground was worked-out and the stopes filled. Below this level the lode widened to a maximum of 6 metres. The next level below was distant 80 m., measured on the dip, which was 45°. The method of stoping was as follows: Suitable winzes having been sunk, sub-levels were driven about 20 m. apart. The winzes were a source of much trouble, as the dry-walling was perpetually getting out of place; in the event, they were only able to be kept open long enough to see the work through. Stoping commenced in the upper sub-level, which was first widened to the full size of the lode and the roof supported, wherever it showed signs of weakness, by pillars of dry masonry. Next, the actual stoping began; a horizontal cut of about 18 in. being taken

along the whole length of the stope, starting from the hanging-wall side, avoiding the pillars and leaving the foot-wall until last, so as to get an arching effect; the ore falling down passes to the cars on the main level below. Filling was then run down special passes, from the old stopes above, and spread evenly over the floor. After filling, the space between 'gob' and back was only sufficient to allow of a man passing on hands and knees. Next,



THE CAMP. ON THE OTHER SIDE OF THE VALLEY, THE STRATIFICATION IS DISCERNIBLE.

dry wall-pillars were erected on the filling, and the old ones taken out; the stones being specially selected and valuable. The above order of events was repeated over and over again until the sub-level was stoped-out. The same course of procedure was adopted in No. 2, which utilized the filling from No. 1, which latter was then allowed to cave.

To avoid shovelling as much as possible, side inclines were made from the waste-filling passes so as to distribute the material; and also into the chutes, for the readier handling of the ore. No supporting pillars were left

under sub-levels. When the stope from No. 2 sub-level approached No. 1 a rise was made at the inside end of the stope into the filling remaining in No. 1. The shell was then sliced till it caved, bringing down the remaining ore and filling the stope behind with waste. This caving was continued forward till the remaining shell was extracted and the stope filled. The length of the ground thus attacked was 40 m., and the average width about 4 m., with a maximum width of 6 m. Big caves occurred on the hanging wall, and these large blocks were broken for use as filling. The chief danger was not so much from the hanging wall, as from the fact that part of the lode was formed of fine stuff, closely packed, which could not be 'sounded' and was liable, therefore, to come away without warning.

As showing what can be done with the inefficient native labour, if properly supervised, it is necessary to add that the above stoping was carried out by Charles Albertson, the mine captain, without other white assistance.

At the Tucsubuma mine, in the southeasterly portion of the district, underground operations are confined to prospecting; the ore for the mill being obtained by quarrying a large deposit at the surface of the hill and immediately behind and above the mill. The Tucsubuma people estimate that they have ore for several years ahead of the mill in this quarry and so are better off than most Bolivian mines, where the lack of development can best be described as chronic. I do not imply that special credit is due to the Tucsubuma people on the score of having kept development well ahead intentionally (the surface deposit was discovered fortuitously, comparatively recently) but that they are specially favoured by a natural occurrence. The Tucsubuma lode strikes parallel with the crest of the hill and dips parallel with the surface of the hill and almost as flatly, the result being that a comparatively large body of ore is put in sight by the mere fact of the lode, which is from two to six metres wide, dipping at 45° and outcropping on the side of a hill the surface of which slopes at about 35°. The quarry is several hundred metres long. Cross-lodes extend into the hill. In places the country-rock carries cassiterite in minute fissures partaking of the nature of a 'stock-work.' Such occurrences rapidly increase the available ore reserve. Sulphides are encountered at only a few metres below the level of the quarry.

Description of Mines.—This district has been known as a mining region from ancient

times. Tradition has it that there are 400 *antiguas* on the hill and that at one time the Spaniards had 2000 Indians working here, till the latter revolted and killed their masters. The number and extent of the old workings and old dumps is surprising. Since ancient times the mines have not been worked seriously until in quite recent years, when they were avowedly worked for tin. Yet, thousands of tons have been taken out of the best tin lodes by the ancients. Did the ancients work these lodes for silver?

Concentrates, where the concentration has been 40 into 1, produced from ore from the same part of the same lodes carry today 6 oz. silver per ton. I have never heard it said that the Spaniards exported tin from Alta Peru.

Another theory to account for the existence of such extensive old workings on tin lodes is that the Viceroy being unceasingly pressed from headquarters for silver, augmented the supply with tin, either by alloying or by having tin used locally for silver. Against this idea is the lack of old Peruvian coins containing a large proportion of tin. If that is not so, the only other explanation is that the Spaniards had an enormous amount of prospecting done by their slaves, the Indians, on the off-chance, merely, of finding silver. Perhaps this is the correct solution; in which case, it is difficult to account for another local tradition to the effect that a lost mine in this district produced fabulous sums in silver.

The principal mines of the district are Berenguela, Tucsubuma, Jatunkaka, Empresa Hornuni, and Leque; there are numerous other small prospects. Of these, Berenguela and Tucsubuma have been producing for some years with the aid of machinery. Jatunkaka has been devoting attention to development while maintaining a small production of *barrilla* with hand appliances. A modern mill is now being erected. Empresa Hornuni has a peculiarly arranged mill and a mine that is not opened-up, but is well regarded by the miners who have worked there. The mill is driven by a portable steam-engine. As firewood, delivered at Hornuni, costs B. 3 per quintal of 100 Spanish pounds, the plant can only be run at a loss. *Taquia* (llama dung) and *yareta** (a species of moss) are not available in this district. Leque is a promising prospect producing a few quintals of *barrilla* each month by hand appliances.

Local Mills.—It is perhaps hardly fair to describe too minutely the methods of tin-

* See *The Mining Magazine*, December 1913, page 451.

dressing employed at the moment in this district, for the reason that both the mill at Berenguela and that at Tucuhuma are undergoing improvements: There are no other mills using machinery in the district. The method of grinding and dressing tin ores by hand appliances in Bolivia is decidedly interesting, and, in the case of rich ore, not nearly so inefficient as might be imagined. A great advantage of the system is that practically no big outlay has to be incurred.

In considering the design of a mill, or improvements to an existing mill, in this district, and in most others in Bolivia, the following points must be borne in mind:

- (1). Any machinery will probably have to be purchased out of earnings.
- (2). Machinery will probably have to be sectionalized.
- (3). Excessive cost of power limits the number of machines it is desirable to run.
- (4). The chief aim is not so much to attain to theoretical perfection of recovery as to get the biggest possible return for money spent.

As an example of (3) most of the concentrate in the Berenguela mill is taken from the tables comparatively dirty and is cleaned by hand, in order to give greater capacity and diminish loss in tailing.

The form of power mostly favoured is the Diesel engine burning paraffin, this being the only form of fuel packed in tins of size sufficiently small to be handled by llamas. Later it is hoped that the railway will see its way to carry crude oil in tank-cars to Colcha.

The Berenguela mill consists of ten 650 lb. stamps, in steel frames (which are unsatisfactory), two trommels, one 2-compartment Harz jig, one Wilfley and one Buss sand-table, one 3½-ft. Huntington mill for re-grinding, two 6-ft. vanners and two 4-ft. vanners, besides several square and round buddles for cleaning concentrate. The Huntington is not running, and two revolving decks for the treatment of slime are yet to be put in operation. Hydraulic classifiers are to be substituted for the trommels and large conical de-waterers are being installed. The amended flow-sheet is shown herewith.

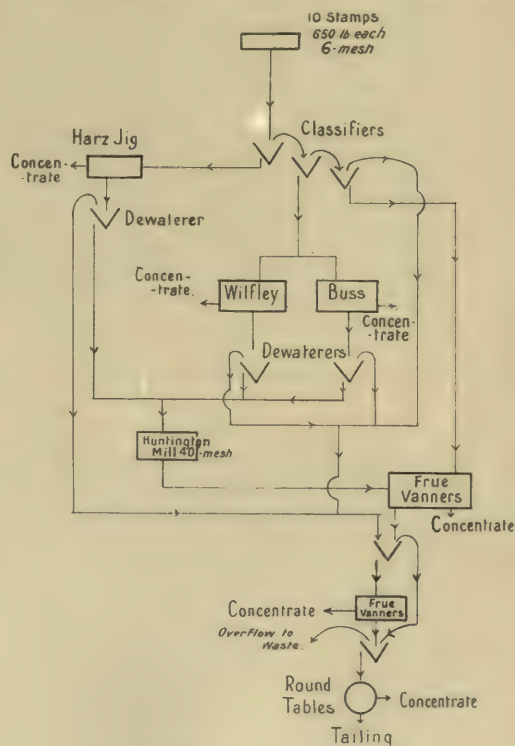
Power is furnished by two 20 h.p. Sulzer Diesel engines with a 12½ h.p. Hornsby-Ackroyd in reserve. These Diesel engines burn, roughly, four tins, of five American gallons of kerosene each, per 24 hours.

The Tucuhuma mill consists of two ball-mills (one in reserve), hydraulic classifiers, one

Harz jig, three Humboldt sand-tables, two overhung vanners, and one revolving deck, besides settling-tanks and pumps for return of wash-water. Power is furnished by one 20 h.p. Sulzer Diesel engine with two 8 h.p. two-cylinder Deutz oil-engines in reserve.

Particulars as to the new mill just begun at Jatunkaka are not yet available, although it will be probably more complete than either of the above, as I infer from the fact two 30 h.p. horizontal Diesel engines are being supplied.

Assaying.—It may be of interest to give a short description of the methods employed at



FLOW-SHEET OF TUCUHUMA MILL.

Berenguela: 25 grammes of ore or concentrate ground to 100-mesh is digested in a flask with hydrochloric acid, then 5 c.c. of nitric acid added and digestion completed. The flask is then filled with water to the brim and inverted upon the vanning-shovel, by which means the solid contents of the flask can be transferred rapidly without loss. As the residue consists entirely of cassiterite and silica, washing on the shovel is simple. The resulting concentrate is dried, weighed, and estimated as follows:

If the sample is a shipping concentrate, product is estimated as 77%; if rich ore 75%;

if battery-feed sample 70%; if low-grade stuff 65% tin.

The reason for the varying scale is that it is not advisable to wash low-grade ore so clean as a *barrilla*, since greater loss would ensue. This is a rough and ready method that gives results close enough for every-day use.

The other method employed is the Pearce assay, using sodium peroxide in iron crucibles, reducing with iron, titrating with deci-normal iodine solution, and standardizing against metallic tin, made by fusing the cassiterite with cyanide. Titration is done as quickly as possible. Sulphide ore has to be roasted before employing this method, otherwise the charge is liable to explode if the proportion of sulphur is high at the time of fusion with sodium peroxide.

The finer the sample is ground, the better. Time is a great consideration on a mine, and if the sample is ground to 100-mesh and assayed in duplicate, the result will probably be equally as accurate as the original sampling underground. To labour in order to make mine assays agree in the second or even in the first place of decimals, is waste of time on a tin mine.

Titanium, tungsten, and bismuth are absent.

The following experiment is of interest: 0.6 grammes of iron filing was fused with sodium peroxide in an iron crucible, reduced with iron, and titrated. The amount of iodine solution required was 0.2 c.c., which, with that strength of iodine solution, was equivalent to 0.06% Sn on a 2-gramme assay. 0.6 gramme of filings was taken, as being equivalent to 30% Fe on a 2-gramme assay, and a greater percentage of iron would not be expected in ordinary mine-work. The result shows that large quantities of iron, fused in iron crucibles and reduced with iron have a negligible effect as far as any ordinary mine-work is concerned. Boiled, not distilled, water is used, as the latter is not available. The boiled water requires one drop of the iodine solution. The starch solution is made fresh every day.

Costs.—It is not within the scope of the present article to give detailed costs per ton of ore mined and milled and of *barrilla* produced, nor to tabulate milling results, as recorded here at Berenguela. Nevertheless, some general figures may be useful to those studying Bolivian mining conditions.

Exchange fluctuates, although not to such an extent as in Chile. The Bolivian dollar is at present worth 17½d., whereas a year ago

it was worth one penny more. This fall is largely influenced by the fall in the price of tin, and this fact, that exchange is sensitive to the price of tin, is of appreciable assistance to Bolivian operators. This important and interesting dependence of Bolivian exchange on the prevailing price of tin is due to the fact that a considerable proportion of Bolivian revenue is derived from the export duties on tin ore.

The scale of export duties ruling today is as follows:

| Price of Straits Metal. | Export Duty in Bolivianos per metric quintal of 100 kilo. |
|-------------------------|---|
| Below £100. | 2'00 |
| £100-£110. | 2'20 |
| £110-£120. | 2'85 |
| £120-£130. | 3'50 |

The rise being 65 cents for every ten pounds increase in price of Straits tin in London. The official table is calculated up to a price of £300 per ton. The ruling rate is fixed by the authorities once every fortnight and the price of tin taken is always slightly above that which actually ruled for the previous fortnight. In other words, the Government favours itself.

The scale of wages ruling in the Berenguela district is as follows: Transport of *barrilla* to Oruro is effected by llamas, the cost per quintal of 100 Spanish pounds being B. 2. A llama will carry one quintal. 21.7 Spanish quintals is a close approximation for either a metric *tonne* or the English long ton; it is, however, somewhat under the latter. A close approximation for the cost of concentrate, assaying 60% tin, from the mines of this district till sold in London, including all charges whatever, is £36 per ton. With tin at £130, a ton of 60% *barrilla* is worth £78; therefore the margin is £42 to cover mining, milling, repairs, depreciation, office, overhead, and any other charges. It is clear that £130 for tin is pretty close to the limit, below which most Bolivian mines will fail to pay expenses.

Conclusion.—Although this district has been known from ancient times, it can be said that little is yet ascertainable as to its ultimate future possibilities. In general, it can be said that the more the different properties are explored the more encouragement is obtained to pursue investigation. One noteworthy feature is that all these mines or prospects are situated on one hill and within a relatively small area. The railway is at the foot of the hill. There are two main streams at the foot of the mountain, either of which would be capable of fur-

nishing 150 h.p. per kilometre. There is, therefore, plenty of hydraulic power available in the district.

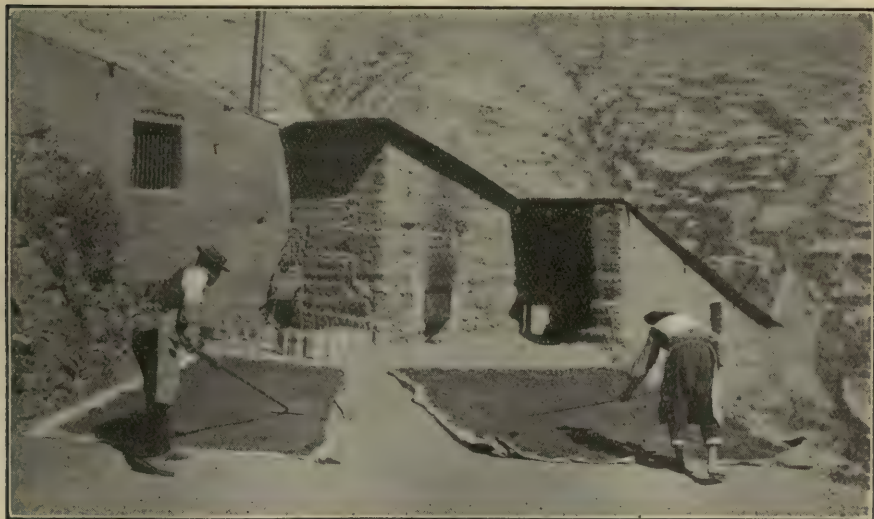
As in all tin mines, the future will depend

therefore, that some day all the mines will become one concern, united by ropeways to a central mill alongside the railway, and that hydro-electric power will replace the small



TIN CONCENTRATE IN SACKS, READY FOR SHIPMENT.

On the right is the Arriero; note his satchel for holding coca. In the background are the transport animals, llamas.



DRYING BARRILLA, OR TIN CONCENTRATE, BEFORE SHIPMENT.

on the ore encountered in the sulphide zone. The lowest working in the district discloses pyrite richer in cassiterite than the oxidized ore at present being mined. It would seem,

individual Diesel units. The scale of operations would be increased many times and the cost of production would be one half of that at present obtaining.

STAMP-MILL TEST.

Competitive Tests of Californian and Nissen Stamps on Tin Ore.

By E. S. KING.

STAMP-MILLING has been receiving considerable attention during recent years, and several improvements and patent stamps have been placed on the market with some success. In view of the claims made for various types of mill, I decided to make a test between two of them, permission having been kindly granted by my board of directors. The plant was erected at Tincroft, which has the distinction of possessing one of the oldest reduction works in Cornwall. Accordingly, two Nissen single-stamp mills were obtained, also a Sandycroft five-head Californian stamp-mill. These two units started crushing in June last, and the figures of the comparative test are now available. Each Nissen stamp weighed 2000 lb., while each of the five Californian stamps weighed 1250 lb. The two batteries were driven by independent electric motors, the consumption of power being carefully checked and tabulated by the Cornwall Power Company. Only the coarse material that passed over the grizzly was sent to the breakers feeding the mills, the fine being diverted to the old Cornish battery for treatment. Both mills of course would have shown higher capacities had the fine been included. In each case, the screen was of 10-mesh standard.

RESULT OF TEST FROM JUNE 18 TO JULY 16, 1914.

| | CALIFORNIAN. | NISSEN. |
|--------------------------------|--------------|---------|
| Tons crushed | 854'44 | 562'03 |
| Total run, in days..... | 23'89 | 24'61 |
| Tons per day..... | 35'765 | 22'837 |
| Stamp-duty | 7'153 | 11'418 |
| Total horse-power consumed | 16'231 | 12'176 |
| Horse-power per ton crushed | | |
| per hour | 10'959 | 12'796 |
| Tons per horse-power per day | 2'19 | 1'875 |
| Cost of power per ton in pence | 5'319 | 6'211 |

The average grading analysis of the product was as follows:

| | CALIFORNIAN. | NISSEN. |
|------------|--------------|---------|
| Mesh | % | % |
| 20 | 13'37 | 15'63 |
| 30 | 15'61 | 15'97 |
| 40 | 9'21 | 8'30 |
| 60 | 12'08 | 11'88 |
| 100 | 10'55 | 9'94 |
| 150 | 9'43 | 8'13 |
| 200 | 3'03 | 3'20 |
| —200 | 26'40 | 26'63 |
| | 99'68 | 99'68 |

These figures do not show any great difference in the grade of the pulp from the two mills. The duration of the trial being under a month, the cost of maintenance could not be estimated accurately.

The five-head mortar-box was specially designed by myself in accordance with previous experience in Western Australia. The box was of the straight-backed type with detachable front, rounded corners (to strengthen), cast-steel liners standing 12 in. above the dies and bolted in position with countersunk headed bolts. The high crushing capacity is mainly due to the small area between the shoes and the box, this being only 1 inch, and ensures a quick return of the uncrushed pulp to the dies. The screen was made to fit so that the bottom was flush with the inside liner. This was done by putting a filling piece at the bottom of the screen-frame with the sides tapering to nothing at the top. The object is two-fold: (1) it puts the screen nearer to the stamps, and stops any clogging on the inside lip of the box; (2) it gives a greater angle to the screen, thus allowing for a quicker discharge of sand than if the screen was vertical.

The stems used were of 4 in. diam., and were shorter than usual by some 4 or 5 feet, and this, I would point out, reduced the vibration and friction to a minimum. The order of the drop was 1, 3, 5, 2, 4.

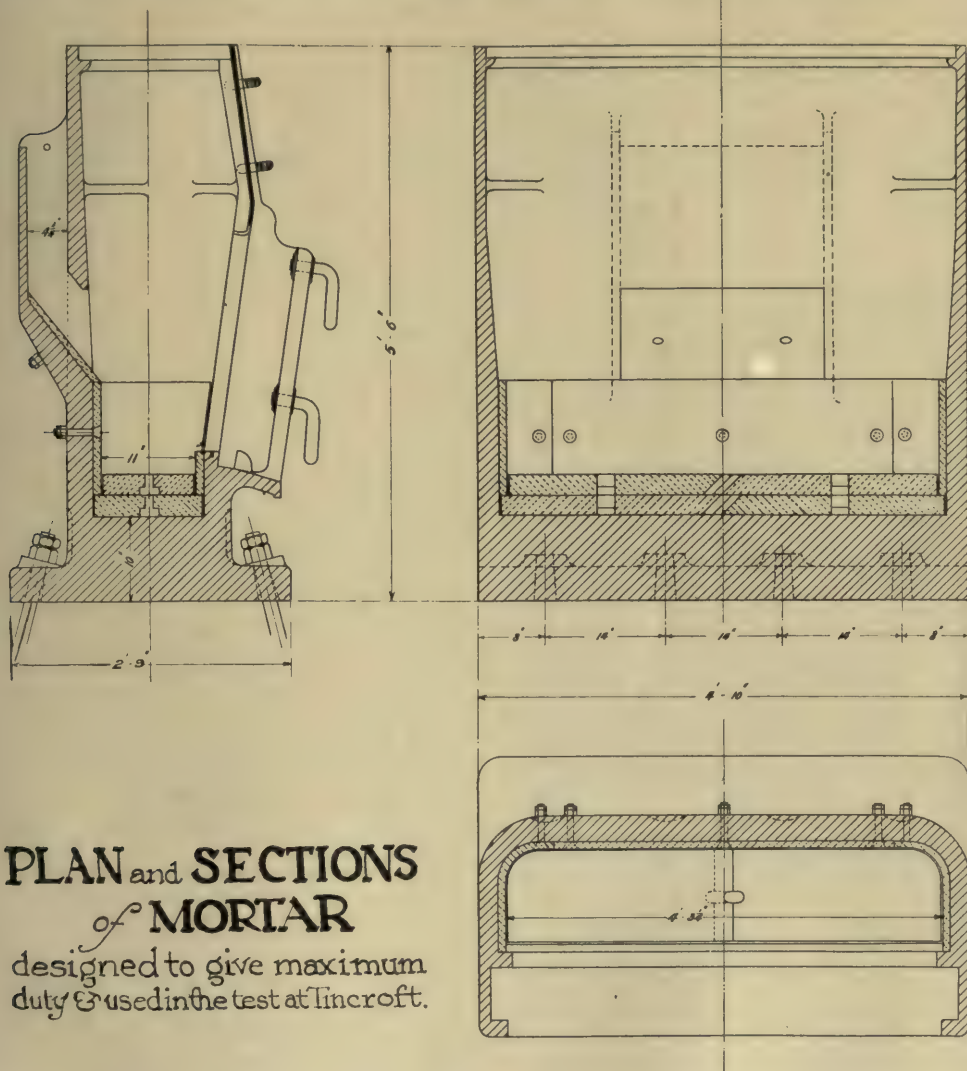
The success of a Californian battery, I contend, is due principally to having a properly designed mortar-box, the stamps falling exactly on the dies well under the cam-shaft. This cannot be done, unless you have strong iron guides (same as were used in this test) and dies made to fit the box.

Many mill-men make the mistake of having the base of the dies too small, and putting pieces of iron between them to keep them in position. This is a bad policy, for in the event of one piece of iron getting dislodged, it throws the whole of the dies out of place, thereby at once reducing the crushing surface and efficiency. Hitherto, the necessary space for inside gold and silver amalgamation had previously, more or less, influenced the standard design of the Californian mortar-box, but in this case, in view of obtaining the

greatest capacity, it was entirely disregarded.

In Western Australia, the use of cyanide in place of amalgamation brought about this welcome improvement, and the old boxes

In conclusion, I would say that the results of the test bear out my contention that a properly designed Californian mill still holds its own as an efficient crushing-machine.



PLAN and SECTIONS of MORTAR

designed to give maximum
duty & used in the test at Lincroft.

packed with hardwood and steel plates gave us the following capacities, equal to an increase of over 50% on previous results.

| Screen. | Weight of Stamps. | Duty. |
|---------|-------------------|-------|
| 30 mesh | 1050 lb. | 4'76 |
| 20 do. | do. | 6'27 |
| 10 do. | do. | 8'90 |

These results were obtained on ore containing 50 to 60% granite, therefore on clean quartz, it can be assumed, a much better duty would have been obtained; for example, a month's run on good ore with 20 mesh screens gave a duty of 6'7 tons.

[This is the record of an interesting experiment, but as it tends to contradict, for example, the elaborate tests made by the City Deep company, it calls for further comment, which will be welcomed from those cognizant of the conditions obtaining in Cornwall.—EDITOR.]

A volcanic eruption has occurred at White island, off the north coast of the northern island of New Zealand. The sulphur deposits on this island have been worked for two years. The hill-side on which the deposits were situated has fallen into the crater.

ANCIENT MINES.

Reminiscences of Old Workings in India, Ivory Colony, and Egypt.

By WILLIAM CROSS.

AS an old prospector who has travelled far and is deeply interested in mining generally, I have always been interested in the articles inserted in your magazine relating to the discoveries of ancient workings and the diligent research by men like Mr. Courtenay de Kalb to fathom their histories. Mr. de Kalb's article appearing in your May number of the current year was full of instructive and delightful reading to the mining man.

There is a tremendous fascination to the prospector in the discovery of old mines, no matter in which part of the world they are found, and the further search for the minerals that the ancients so strenuously sought to win, with their crude tools, persevering even to great depths. In the Deccan, India, I found they had excavated quartz down to a depth of 640 ft., a great depth considering their tools, as the country around the Hutti Nizam's mine is fairly flat and there are many feet of black cotton soil overburdening the true rock surface. One can imagine the old miners' difficulties in getting rid of the water at this depth, having no doubt to abandon any further effort to sink beyond the depth mentioned, and leaving it to the engineers one thousand years later to cope with it. The ancients of India in mining gold-bearing quartz generally operated in open workings, though we sometimes see places where adits have been driven and the ore stoped, the weak walls being supported by stulls. These stulls when removed are found to have been converted almost into rock, and some of them from the Hutti Nizam's old workings at depth were as good as the day they were put in, and as black as ebony. Such articles as rulers, walking-sticks, paper-weights, etc., made from them in the lathe, served as interesting curios to send home.

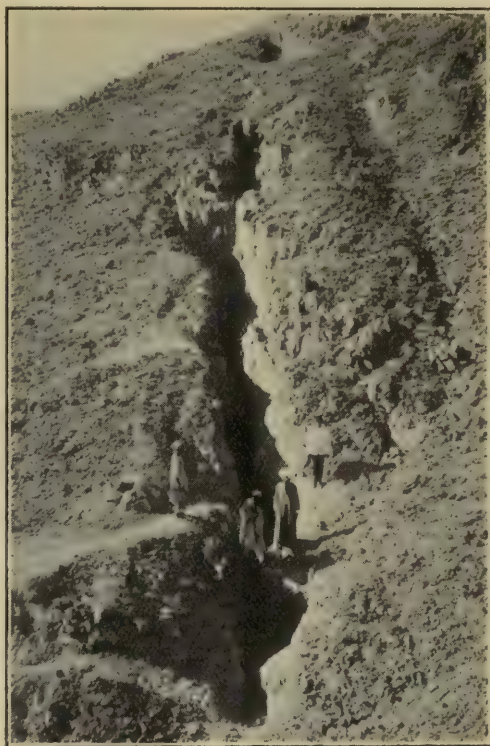
The savage tribes in the interior of the Ivory Colony, French West Africa, whose acquaintance I made in years gone-by, followed a system of mining I had never seen before. Their method of winning the gold from the small veins must have entailed much hard labour, for their workings were found in a fairly high hill composed of dark red clayey soil, whose summit of grape iron

must have been difficult to penetrate. Yet holes had been forced through, even at the top, to get at the small rich veins that were found running through the hill almost horizontally from 20 to 30 ft. apart. Terraces were cut about every 40 ft. around the hill, and a line of shafts, hundreds in number, put down, only about six inches apart, the general size being only 18 in. to 2 ft. diameter, and almost perfectly round, reaching to a depth of 150 ft., and as vertical as a plumb would drop. Every 15 ft. or so a hole would be made in the side parallel to the next hole, and as you were lowered down you could see right through a section of 20 and 30 holes, cutting the small veins. These had been gouged out with a sharp-pointed stick as far as the native could reach; and this kind of thing continued until the bottom was reached, where a passage broke through the entire length, and you could gaze upward, the resemblance being not unlike a set of organ-pipes. The quartz obtained from these novel workings, of which the number around the hill seemed legion, was carried and stored in large cellars under the village, every house having its underground storage. When the rainy season was over, these cellars were opened and crushing commenced in the usual primitive way, with a flat stone, a grass-woven ring, and a hammer made of a hard ball of quartz. The primitive mill-man would sit for hours beating the gold-bearing quartz to powder, the grass ring keeping the dust from getting too far away. Afterward the ladies, who were marvellously expert with the wooden batea, washed the crushed ore. Hearing a continuous tapping one day in the bush, I made toward the sound, and here I found two natives hard at work, one in a hole many feet under the roots of a large tree with his iron-topped stick hooking out lumps of quartz and tossing them up to his partner, who with his stone hammer was breaking them and blowing a damp breath on the broken parts, searching for visible gold. Judging from the pile alongside, they were not working in vain. These cannibal tribes, absolutely nude as to both sexes, refused to sell me their gold under £3. 12s. per ounce, and I have often wondered to what use all their gold was put. It was

not an unusual sight to come across as many as 60 women, with their three bateas each, washing the gravel of the gold-bearing streams in those parts.

I was one of the pioneers in Egypt when stories of marvellous discoveries of gold were circulated and ancient workings were found, both in Egypt and the Sudan. I believe that many who invested during the boom at that time have wished that these old mines had never been brought to light again, but to the prospector or the mining man who was not simply aiming at dividends these discoveries were sources of delight as he endeavoured to probe the history of the ancients and find out their method of working these lodes of hard quartz. As the modern miner penetrated the old workings he was ever hopeful that he might find a mine that would prove a success and become a profit-sharing concern. I have the honour of being the discoverer of the only dividend-paying gold-mine in Egypt, namely, the Barramia mine, situated about 60 miles east of Edfu, and it is of these enormous old workings that I should like to say something. Old mines were found prior to my arrival, and these were diligently exploited by those in charge; but as they were not proving rich enough and were of no great length, the superintendent desired me to accompany him on a prospecting tour over the concession. After nine days' wandering he wanted to get back to camp, as we had up to then been unsuccessful; but noticing signs, in the distance, of what I imagined were old dumps, I prevailed on him to see if I was correct. I felt confident from other signs, such as houses on each side of the wady, that we were approaching some old cantonment and probably old workings. This proved to be correct in both cases, and my boss thanked me for prevailing on him to go a little farther. We had found one of the richest discoveries of modern times. A few months later, while I was in charge, clearing and re-opening these immense workings, a winze revealed quartz actually held together by the precious metal, a regular jeweller's shop, as a Cornishman would say. Though I got no material remuneration for this rich discovery I shall always feel proud that it provided recompense for its shareholders. It is, however, the great length of these ancient workings that absorbs the attention of the mining engineer, and the numerous stopes, cross-cuts, winzes, black-rock boxes for worthless stunts, passages cut from the deep workings below to the surface with steps every 18 inches, an adit with an entrance over which a

Sphinx is carved, long stone stulls of porphyry, which when removed and sounded give a beautiful musical tone, and great stopes walled-up strongly at the open end, supported underneath by porphyry stulls, hitched and cut to fit at the proper angle. Though thousands of years have passed since these boxes were made, they stand today as firm as ever. Cross-cuts to cut smaller veins were very low, not more than 30 inches high, and through this cramped space goodly distances were driven and stopes were worked from them. Every few feet along the old stopes you would find small niches cut in the hanging-wall, where the miner put his little clay cruse-lamp;



OLD WORKINGS OF THE BARRAMIA MINE, SUDAN.

I found one intact after this long lapse of three thousand years. I also found a basket and the angle-shaped wood scraper, which were used to collect the finer part of the quartz, the basket being woven of fine grass and covered with camel skin. Fire had evidently been used in some places, as indicated by the charcoal still remaining and the blackened roofs, but in many places the ore had been chiselled out by a strong-tempered tool. At some points, especially in the adit already

mentioned, it could be seen that the bit had been half an inch wide, and the distance each blow had forced the chisel or wedge could be judged. Tablets are to be found that might throw some light on this great old working, but I have not met an authority on hieroglyphics to decipher them. A fairly large cantonment is in the valley, with its 4-ft. thick wall, and in the centre is an excavation 40 ft. long by 18 ft. broad, cut downward in a mica schist to 62 ft., a foot-way leading down the side and end. Here water had been stored. At the end was a cemented trough, leading into 3 large rooms about 10 ft. below the level of the ground. Evidently hand-washing of the gold was done here, as a large mound of tailing was close-by outside the walls. Water had been conveyed in round clay pipes to a bathroom, which, when cleared, showed 7 baths built in a half-circle, where the bathers could sit on the raised bench and talk while the attendants washed their feet. Cisterns were built into the walls to give a supply of water, and a private bath could be had in a room adjoining, where a 6-ft. bath was in good preservation. The floors and walls were plastered with a fine smooth mixture, not unlike plaster of paris, and here no doubt the officers of this ancient mine enjoyed their daily ablutions. On a small hill facing in the direction of the Nile had been a large and fine building, for there lay in evidence large columns beautifully carved and large sandstone blocks richly ornamented. It is easily imagined that to anyone approaching from the Egyptian side how well the building on its high elevation would look with its massive masonry, now scattered never to be raised again. Scores of dried wall-built houses on each side of the wady pointed to a large population in those far-off days. By digging to the floor large stone mills are found, some quite intact, some worn right through. Up the valley are extensive crushing floors, with the curious bevelled stones with handles, so heavy as to make grinding no easy task. On our first arrival we found a number of dumps of broken quartz neatly formed about a yard high, and at the corners there still remained the breaking block and hammer, giving the impression that the worker had just gone for his dinner and would be ready to start again after his meal. As we looked at this hill, rising to 400 ft. and over a mile in length and almost split from end to end to a depth of 120 ft. below the bottom of the wady, and then looked at the old buildings around, not forgetting the evidences of skill displayed in

winning the gold, we judged that surely here was evidence enough that these nations now past and gone in the year 3000 B.C. were people who had a knowledge enabling them to work the hardest of rocks, and that for many generations, from its first discovery, gold in probably large quantities was taken year by year from this mine.

Machine Coal-Mining.

According to returns made by the United States Bureau of Mines, the use of coal-cutting machinery is rapidly advancing. In the year 1900, about 20% of the output was won in this way, whereas in 1913 the proportion had risen to 46%. In Great Britain the advance has also been notable, but is still far behind that of the United States, for in 1913 only 9% of the output was won by machines. The following tables give the number of machines in use, the amount of coal won by machines, and the output per machine during the last few years. During the same time, the total United States production advanced from 240,800,000 tons in 1900, to 509,000,000 tons in 1913, and the British production from 225,000,000 tons to 287,000,000 tons. Of the various types of machine, there were in 1913 in Great Britain, 1246 disc, 542 bar, 250 chain, 839 percussive, and 17 rotary heading machines. In the United States the classification was: 6327 pick, 6936 chain-breast, 791 longwall, 2210 shortwall, and 117 radial or post machines.

UNITED KINGDOM.

| Years. | Machines in use. | Coal won. | Production per Machine. |
|--------|------------------|------------|-------------------------|
| | No. | Tons. | Tons. |
| 1900 | 311 | 3,312,000 | 10,650 |
| 1902 | 478 | 4,161,200 | 8,706 |
| 1905 | 946 | 8,102,200 | 8,564 |
| 1906 | 1,136 | 10,202,500 | 8,981 |
| 1910 | 1,959 | 15,878,800 | 8,105 |
| 1911 | 2,146 | 18,667,300 | 8,698 |
| 1912 | 2,444 | 20,274,100 | 8,295 |
| 1913 | 2,894 | 24,609,300 | 8,503 |

UNITED STATES.

| Year. | Machines in use. | Coal won. | Production per Machine. |
|-------|------------------|-------------|-------------------------|
| | No. | Tons. | Tons. |
| 1900 | 3,907 | 47,129,000 | 12,062 |
| 1902 | 5,418 | 62,153,300 | 11,471 |
| 1905 | 9,184 | 92,318,200 | 10,052 |
| 1906 | 10,212 | 106,113,800 | 10,390 |
| 1910 | 13,254 | 155,368,100 | 11,722 |
| 1911 | 13,829 | 159,070,000 | 11,503 |
| 1912 | 15,298 | 187,981,100 | 12,280 |
| 1913 | 16,381 | 216,496,900 | 13,216 |

PRECIS OF TECHNOLOGY

[Copies of the original papers and articles mentioned under this heading can be obtained on application to the Technical Bookshop, Salisbury House, London E.C., the book department of *The Mining Magazine*.]

Persistence of Ore in Depth.—At the November meeting of the Institution of Mining and Metallurgy, T. A. Rickard presented a paper giving by fact and argument the reasons for discrediting the supposition that orebodies may be expected to persist indefinitely in depth. The old idea was that, as the specific gravity of the earth is three times that of the rocky crust, the proportion of metal in lodes would prove to be greater with depth, and all that a poor mine wanted was more development. Later scientific investigations have shown, however, that metals coming from below have travelled in the form of hot solutions, and that they have been deposited at shallow depths as the temperature and pressure decreased. Moreover, many of the enrichments constituting ore have been caused by waters circulating in the upper parts of the earth's crust, such waters being of either magmatic or meteoric origin. From these facts the author shows that the richer ores are more likely to be near the surface than at great depth. In his paper, he quotes the experience of geologists and engineers tending to prove the principle of general impoverishment in depth, and he describes in detail several representative instances of successful deep mining, where, however, impoverishment is in evidence. The exceptional example of persistence exhibited by the St. John del Rey is treated at some length, and the information and plans, hitherto unpublished, relating to this mine give additional value to the paper.

With so much interesting matter it is difficult to write a précis of the paper, but it may be of interest to quote remarks on one particular phase of the subject. It has been presumed by many authorities that metal-bearing lodes found in ancient eroded rocks had continued upward through the eroded portion to the original surface, that is to say, that either the formation of the lodes or the concentration of their metal contents had happened before the period of erosion. This argument has been used by engineers in various parts of the world, notably Nova Scotia and Western Australia, to encourage the notion of persistence in depth in Palæozoic rocks, for it is argued that if a lode in what is granted to be the stump of an old continent is shown to extend to a depth of 3000 ft., similar lodes must have been originally 8000 or 10,000 ft. deep and may still continue indefinitely; moreover that lodes discovered at points admittedly at or near the original surface of ancient rocks may be expected to persist to very great depth. To this the author replies that the lodes may or may not have been formed before erosion, and that in any case the ore-bearing parts of the lodes may not have been formed until long after the erosion, in a much later geological period; that is to say, the parts of the lodes now working may be the result of later chemical reactions long post-dating the circulation of the waters that deposited the primary ore. He quotes the case of the gold veins in the pre-Cambrian rocks in Nova Scotia. Geologists have shown that the rocks were originally much thicker, and that quite five miles of overlying rock has been removed. Local engineers argued that as the gold veins had presumably persisted from the original surface through this five miles of rock they might be expected to continue downward through the remaining three miles of similar rock. Unfortunately experience has shown that no vein in the region has been followed profitably for

more than 1100 ft. and that on most of the mines operations have ceased at from 200 to 300 ft.

The author also quotes the case of the Homestake, in South Dakota, where the gold-bearing lode is of pre-Cambrian age, but where the enrichment to form ore belonged to post-Cretaceous time. The lode is a mineralized zone in schist of pre-Cambrian age. In the overlying conglomerate, of Cambrian age, are found boulders that are recognizable as eroded fragments of the lode-schist. This conglomerate contains enough gold to be exploited as ore. Emmons showed that while some of the gold in the conglomerate is detrital and derived from the original pre-Cambrian lode, the high-grade portions were due to secondary enrichment, and that the detrital deposit was enriched by a process of chemical precipitation by the circulation of thermal waters following a rhyolite flow of Eocene age. Thus it is shown that though gold was deposited in ancient times averaging 1 dw. per ton of lode-matter, the workable orebodies were formed in recent times.

The paper is sure to evoke much discussion, and should serve to define the views of the mining profession on a subject of prime importance.

German Coal-Interests in Yorkshire.—Much has been heard lately of the Harworth colliery in the south Yorkshire coalfield, operated by German capital with German workmen. The facts of the case are given in the *Engineer* for November 6. The property was purchased in the summer of 1913, an English company called the Northern Union Mining Co., Ltd., being formed for the purpose. The directors are Hugo Stinnes of Mulheim-Ruhr, Gustav Knepper of Bochum, both in Westfalia, James Russell Ferguson, and Arnold Lupton, formerly professor of mining in the University of Leeds and member of parliament for the Sleaford division of Lincolnshire. Mr. Lupton held an option on the Harworth royalties for some years, and may be taken to have been the promoter of the enterprise. Mr. Stinnes is a prominent German coal merchant, having purchasing agencies in this country, and he is the head of the group that has large interests in connection with the Turkish coal trade. Mr. Ferguson is Mr. Stinnes' English representative. The *Engineer* describes the Harworth estate as covering over 15,000 acres situated 8 to 10 miles southeast of Doncaster, partly in Yorkshire but chiefly in Nottinghamshire, and reports that the reserves contained in this area amount to 750,000,000 tons. For the purpose of development the area was divided into two sections, and arrangements were made for two separate sinkings, one at Harworth and the other farther south at Blyth. Nothing has been done as yet at Blyth. Operations were commenced at Harworth in March. A branch line was built to connect with the Great Northern railway at Scrooby. The coal belongs to the celebrated 'Barnsley' seam, and is expected to be cut at a depth of 2400 ft. The scheme calls for a yearly output of 1½ million tons, and the erection of coke-ovens with a capacity of 5000 tons per week. Though an English manager was in charge of sinking operations, the whole of the skilled labour was imported from Germany. Most of the men were interned on the outbreak of the war, and operations are suspended. Some negotiations have been undertaken for the purchase of the property by an English syndicate, but the principle of transfer for profit to the enemy blocks the way. As sinking had only been proceeding for four or five months, no great progress had been made, and another two years would have been occupied before any coal could be marketed. The method adopted for the hoisting of the coal was new as far as Yorkshire was concerned, though it had

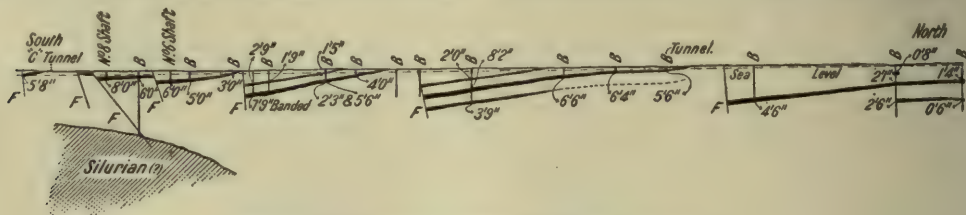
been used many years ago in the Durham coalfield. The ordinary practice is, of course, to equip each shaft with one winding-engine and one large drum from which the cages on each side of the shaft centre are raised and lowered simultaneously. At Harworth there were to be two winding-engines to each shaft, and the cages were to be raised and lowered independently. Though the first cost would be greater, it was claimed that the output would be much larger. An advantage would also be gained if coal were being raised from two seams concurrently. The hoisting plant has however not been erected, so whether the method will be eventually adopted or not remains to be seen.

Secondary Metals.—In the United States the term 'secondary metal' is applied to the metal recovered from scrap and dross, while 'primary' denotes the metal produced direct from ore. The recovery of metal from scrap is a big business in America and Europe, and the metal thus placed on the market approximates 20% of the consumption. Some of the scrap comes from the factories and workshops and is clean and unused, while other supplies consist of worn and broken metal that has already done service, and of dross and skimmings from the foundries and metal works. The United States Geological Survey under-

dross and skimmings. Of the remainder, 25,653 tons was a constituent in brass and 3912 tons in other alloys. It is estimated that in addition 15,000 tons of zinc chloride was produced from dross and skimmings and several thousand tons in the form of the pigment lithopone. Of secondary antimony 2705 tons was recovered, nearly all of it in alloys.

The production of secondary tin was 14,178 tons, or 27% of the import of primary tin; of this, 6415 tons was in the form of metal and 7763 tons in alloys and chemical compounds. The largest proportion of the tin came from the drosses made during the manufacture of tin-plate. The electrolytic de-tinning plant of the Vulcan company was destroyed by fire, so its output was suspended, but other firms report the electrolytic production of a tin powder from scrap tin-plate, requiring re-smelting, while the dry chlorine process and simple melting in furnaces are also reported as being used for stripping tin from plate. Both stannous chloride and stannic tetrachloride are produced. Small amounts of tin are recovered as oxide for enamelling purposes, and as putty powder.

It is estimated that 4654 tons of aluminium was recovered, of which over one half was in the form of an alloy containing 92% aluminium and 8% copper. The pig aluminium was chiefly clean clippings and



SECTION OF THE WONTAGGI COAL DEPOSIT.

takes the collection of statistics relating to the production of secondary non-ferrous metals. No attempt is made to obtain figures relating to iron, though the use of scrap in the foundry and in the open-hearth furnace is extensive. In the figures presented, the individual metal is represented largely by its constituent in alloys; for instance much of the copper and zinc are in the form of brass. The report for 1913 has been prepared by J. P. Dunlop, and we present an outline of it herewith. The output of secondary copper was 136,500 tons, equal to 22% of the production of the metal from United States ores. Of the total, 18,661 tons was produced at smelters and refineries that deal chiefly with ores and primary metal, and the remainder by firms making a specialty of the treatment of scrap. The latter firms produced 36,716 tons of pig copper, 69,520 tons of copper in remelted brass, and 11,603 tons of copper in other alloys. On analysis of the figures we find that about 45,000 tons was recovered from clean scrap made in the course of manufacture of copper and brass ware, and 91,500 tons from material that had been previously used and discarded, and from ashes and dross.

The secondary lead recovered was 72,834 tons, of which 33,104 tons was in the form of pig lead, and 39,730 tons as a constituent of alloys. The pig lead was largely produced from old pipe and sheet, and from type-metal and other hard or antimonial lead. Much of the alloy is metal used for bearings. As regards zinc, the total recovery was 79,570 tons, equal to 23% of the production of primary metal. Of the total, 50,005 tons was in the form of spelter, of which almost exactly one half came from the re-distillation of

borings from the workshops. The total value of the secondary metals recovered during 1913, copper, lead, zinc, tin, antimony, and aluminium, was estimated at \$72,845,000, the figure being based on the average market quotations.

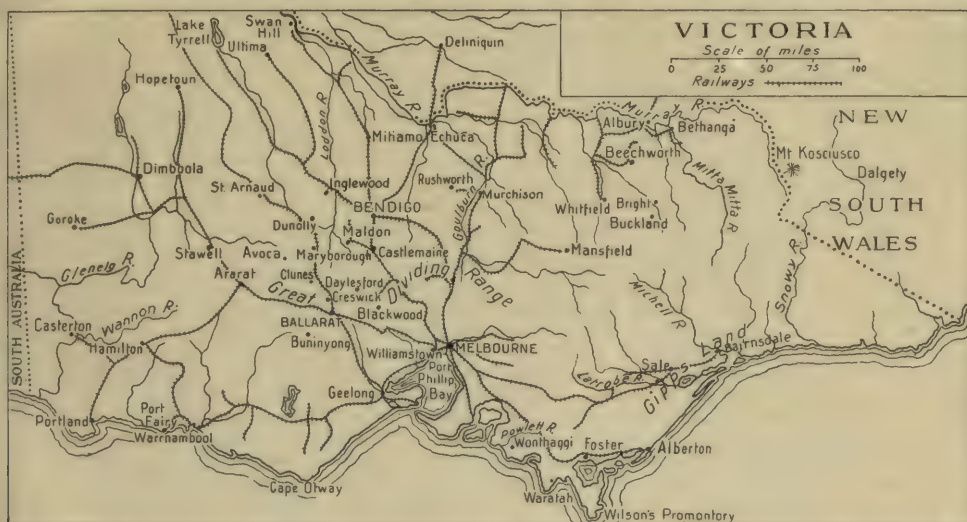
Coal Deposits of Victoria.—The Quarterly Proceedings No. 14 of the Australasian Institute of Mining Engineers, now to hand, contains many papers on the coal deposits of Victoria, constituting in themselves a valuable monograph on the subject. These coal deposits have been known for many years and have been worked intermittently, but it was not until the State authorities determined in 1909 to open a mine at Wonthaggi, in order to obtain a supply independent of the New South Wales coalfields, then convulsed by labour troubles, that the deposits assumed economic importance. We gave in our issue of September last a short outline of the mining methods adopted at Wonthaggi, mentioning that the faulting and thinning of these seams required unusually close attention. We give herewith some notes on the geology of the deposits extracted from the paper read by Stanley Hunter and Leslie Ower, contained in the Proceedings above-mentioned.

The coal deposits of Victoria are divided into two groups according to geologic age, Jurassic and Tertiary; and into three groups according to geographical distribution, namely, South Gippsland, Otway-Geelong, and Wannon River, the last-named being north of Portland, near the South Australian border. The black coal of Jurassic age is found in the Powlett river district of South Gippsland, and the position of the Wonthaggi mine is indicated on the accompanying

map. In the Tertiary strata to the east and north of this district, at Alberton, and in the country lying around the Latrobe river, respectively, are several extensive deposits of brown coal noted as being by far the thickest of anything yet discovered throughout the world. Beds have been proved to be 50, 80, and 140 ft. thick, while in one case a bore showed an aggregate of 781 ft. of coal in a depth of 1010 ft. Its recent formation is shown by the fact that the moisture content on first breaking is from 25 to 50%. In the district between Cape Otway and Geelong, and in the Wannon River district, many seams of Jurassic coal are found, but they are too thin to work. To the north of Geelong, toward Ballarat, there are thick seams of brown coal. All the brown coal found in Victoria crumbles on drying, but it is easily briquetted, and it has been proved to be suitable for the production of power-gas.

The South Gippsland coal-area may be divided into hill country or dissected plateau, and wide plains. The hill country consists of Jurassic strata, either out-

throws have been in progress since early Mesozoic times, and there is evidence that they are still continuing. The Jurassic strata were deposited in one of these depressions, and the conditions of their deposition are proved to have been those of shallow water, the presence of carbonaceous beds, the absence of marine fossils, and the current-bedded nature of many of the strata affording favourable arguments for this conclusion. At the end of the Mesozoic period, local upthrow movements commenced over portions of this area, with the result that parts of the coal seams came to the surface. Then followed the lava outflows. Subsequently came another series of downthrows surrounding the Jurassic rocks now outcropping, as is proved by the basalt being found in bores sunk in outlying districts. Other faulting on a large scale has occurred since the deposition of Tertiary beds on top of the basalt. The faults described above surround the Jurassic rocks of South Gippsland, and, from these, minor fault-lines ramify through the coal-area.



cropping, or covered with basalt flow, and occasionally capped by Tertiary deposits. It is almost entirely surrounded by the plains, which are of Tertiary age. Silurian rocks rise to the surface at Waratah, at Foster, and north of the Latrobe river. Granite is found at Wilson's promontory and at other points. The Silurian rocks are sandstones, mudstones, and slates, and the Jurassic consists of felspathic sandstones, mudstones, sandy slates, and thin lenses of conglomerate. Over the Jurassic rocks are found flows of basalt of Tertiary age, which came up through dikes and pipes. Much of this basalt has been removed by denudation.

Throughout the Jurassic rocks bands of carbonaceous material are found, parallel with the bedding, varying from thin films to workable coal seams. The rock underneath the carbonaceous matter usually consists of mudstone, the origin of which was obviously in tranquil water, such as that of a swamp or lagoon. Most writers on Victorian coal have favoured the theory that it was formed of drifted vegetation. The authors of this paper, however, are of opinion that the coal was a swamp growth on the spot.

The study of earth movements in Victoria is helpful in explaining the faults in the coal deposits. To the south of the Great Dividing Range, continual down-

The so-called sag-movement is characteristic of these faults. It may be described by referring to an area shaped as half of a saucer, with the strata dipping from the arc of the semi-circle toward a point on the diameter at which is the greatest displacement of the fault; this displacement may reach 800 ft. as a maximum, and dies out in both directions on the fault-line. In some places the structure is complicated by the main fault splitting into a series of minor faults before dying-out. The faults and displacements at the Wonthaggi mine may be described as presenting a saw-tooth section in one direction, with sagged strata rising at right angles from the longer slope of the teeth. The accompanying section shows this formation. The material of the fault-channels is soft and in some places thick, and is easily noted in bores and workings. Probably adjustments of strain are still occurring along these lines, though without apparent movement on the surface. The chance of a bore missing the coal by entering a fault-plane is small. A more likely cause of failure in boring is due to the fact that a seam is often squeezed quite thin in the neighbourhood of a fault and may be considered to be of no importance by the foreman-driller. The faulting and thinning are so general that continual boring is necessary.

Characteristics of Refined Copper.—At the September meeting of the American Institute of Metals, Lawrence Addicks, who was for some years manager of the Raritan refining works of the American Smelting & Refining Co., read a paper describing the characteristics of various types of refined copper. The two factors determining these characteristics are the limitations of the processes by which the copper is produced and the requirements of the manufacturing processes in which it is to be employed. As regards the metallurgical processes for production, the modern roasting, smelting, and converting process has the advantage of removing almost completely the impurity-metals that have volatile oxides, such as arsenic, which is the greatest enemy in refined copper. In fact, converter bars are not likely to carry any metal other than gold and silver, unless it is nickel, and the amount of this will not be more than a few hundredths per cent. In the old Welsh process, these impurities were imperfectly removed, but it was possible to segregate them in a portion of the product, so that the 'best selected' required no further treatment by refining. In the case of oxidized copper ores, the proportion of impurities in the black copper produced is high, the fineness never being over 96%, owing generally to iron reduced with the copper.

The refining of copper is effected by fire or by electrolysis. In the fire process, the elimination of impurities is rapid when they are present in considerable amount, but when they exist only as traces, they cannot be slagged-off with any reasonable amount of scori-fying. Therefore furnace refining is necessarily limited in application, either to the treatment of relatively pure crude copper, or to the case where a low-grade refined copper is to be produced. On the other hand, in electrolytic refining, the smallness of the impurity content is directly advantageous, as the selective action of the current in depositing only copper at the cathode is thereby assisted. Of course the prime advantage of electrolysis is the complete recovery of the precious metals. In electrolysis the identity of the anodes is lost and the variation in their physical and chemical characteristics does not affect the characteristics of the cathode copper. Thus it is not necessary when judging electrolytic copper to inquire whether the crude copper was converter bar, black copper, or Lake concentrate, but only to ascertain the actual characteristics of the electrolytic product. The cathodes average 99.95% copper. They are suitable for immediate use in the manufacture of brass, for instance, but in any case it is not advantageous to ship them, as the nodules on the surface are easily detached and copper is lost. They are therefore melted in a reverberatory, by a process that used to be the same as that employed in fire refining. Modifications in handling had to be introduced, however, to prevent impurities being introduced from the gases of combustion, the iron rabbles, etc. Even now it is a fact that the electrical conductivity of wire drawn direct from cathode copper is 2% higher than that drawn from the same copper after melting.

As regards the relative merits of Lake and electrolytic as standards, the copper produced in the early days at the Lake Superior mines was remarkably pure and had the highest conductivity of any produced. Thus for 30 years it was the accepted standard. The first electrolytic copper put on the market was of irregular character owing to the details of the method of refining not having been perfected, and for some time it could not compete with Lake copper. With increasing depth the Lake ores became less pure and arsenic became a constituent. High-conductivity copper was still produced, but a large proportion of the

output gradually became arsenical. Brands of electrolytic, which had been greatly improved in the meantime, were then able to compete with Lake copper containing traces of arsenic, and they took precedence for electrical work. At this juncture the producers of Lake copper found it politic to rely partly on the greater 'working' quality of their metal; that is to say, the copper containing impurities such as arsenic, phosphorus, aluminium, and silica has advantageous characteristics when applied for certain constructional purposes, the very impurities that lower the conductivity being aids in developing desirable mechanical properties. Thus copper containing 0.4% of arsenic has a market for the manufacture of fire-box plates. One of the leading Lake companies has an electrolytic refinery which removes silver and arsenic, and curiously enough its product is classed as Lake and not electrolytic. It is now generally admitted that high-conductivity Lake is indistinguishable from electrolytic, though it must be confessed that the alteration of public opinion is chiefly due to the gradual retirement of the older generation of wire-mill managers. Mr. Addicks says that Lake copper should now be separated into 'pure,' and a graded series of 'alloys with arsenic.'

The refiner, in considering impurities, divides them into three classes: (1) those that depress conductivity, such as arsenic and antimony; (2) those that impair ductility, such as lead, tellurium, and bismuth; and (3) those that are worth recovering, such as gold, silver, platinum, and palladium. The first and third cause no trouble; the first can be regulated by the usual tests, and the metals of the third class are not likely to affect the quality of the copper if present in quantity below the amount that would be profitable to extract by electrolysis. The metals of the second group are the source of difficulty, for those named, and selenium also, make copper brittle even when present in very small quantities. It is impossible to give definite figures for the allowed maximum, for the presence of other impurities may neutralize their bad effect. As far as present knowledge goes, a proportion of lead up to 0.005% has no perceptible effect either in manufacturing wires and sheets or in the making of alloys, but double this amount shows its presence. The detection of lead in copper requires considerable experience on the part of the chemist, for almost always some trace of it can be found, and the exact estimation of such small proportions is difficult.

Precipitation of Gold in Ore Deposits.—In *Economic Geology* for September, Victor Lenher draws attention to the possibility of oxidizing agents being under certain circumstances the cause of the precipitation of gold from circulating solutions. There are so many reducing agents that dissociate gold from its compounds, that geologists have not supposed it necessary to look for any other explanation of the reaction in nature. It is known among chemists that 'auto-reduction' often occurs when oxidizing agents are brought into mutual contact. For instance auto-reduction takes place between permanganate of potash and hydrogen peroxide, between iodates and hydrogen peroxide, and between permanganates and percarbonates or perborates. In these cases the mutual reduction of the oxidizing agents is accompanied by the evolution of gaseous oxygen. Similarly when the oxide of gold is brought into contact with hydrogen peroxide, it is reduced to metal, according to the equation: $\text{Au}_2\text{O}_3 + 3\text{H}_2\text{O}_2 = 2\text{Au} + 3\text{H}_2\text{O} + 3\text{O}_2$. Solutions of gold compounds behave in the same way, the gold being precipitated by hydrogen peroxide, and the precipitation takes place in acid, alkaline, and neutral

solutions. The same thing happens when the solutions are brought into contact with sodium, barium, or calcium peroxides, or with sodium perborate; while nickel and cobalt peroxides, lead dioxide and red lead, and cerium dioxide precipitate gold from solutions that have been rendered alkaline.

The behaviour of manganese compounds are well worth study in this connection. Artificially prepared manganese dioxide and permanganate of potash slowly precipitate gold, and the manganese oxide minerals, pyrolusite, wad, braunite, and manganite behave similarly, the action being most marked in alkaline solutions. A. D. Brokaw, in the *Journal of Geology* for May 1913, noted this reaction with manganese compounds in alkaline solutions. His explanation of these reactions was in the formation of minimal amounts of manganese tetrachloride, which is hydrolysed, removing the manganese from solution, and that this hydrolysis proceeds more efficiently by the neutralization of the free acid formed.

That manganese can be of importance in the deposition of gold is probable, but in addition to the suggested explanation Mr. Lenher shows that a number of other chemical facts must be considered. Auric compounds are readily reduced to metallic gold, hence they can be considered oxidizing agents. In alkaline solution they can oxidize manganous hydroxide to manganese dioxide. Further the neutralization or the rendering alkaline of a manganese solution brings into the system the omnipresent oxygen of the air which, as is well known, causes the deposition of manganese dioxide, which in turn is a precipitant for gold. The manganese oxide deposits in nature are doubtless largely formed by the neutralization of manganese-bearing waters and the oxidation which proceeds simultaneously by the oxygen of the air. The facts that manganese dioxide is a precipitant for gold and that it is presumably largely formed by the oxygen of the air, lead to the conclusion that the real agent in this precipitation of gold by manganese is the oxygen of the air. The system is undoubtedly complex, and the true direction of the reactions between manganese compounds and gold solutions depend largely on the acidity or alkalinity of the solutions and on the time factor, particularly in so far as the oxygen of the air is concerned. The oxygen of the air is by no means necessary in the reaction between alkaline gold solutions and manganese salts, as has been shown by the immediate precipitation of metallic gold and manganese dioxide when experiments were conducted in the absence of air or in the presence of carbon dioxide in solutions that had been boiled until air-free. The mutual precipitation of gold and manganese dioxide by calcite cited by Mr. Brokaw is held to be simply the neutralization of the acid liberated in the hydrolysis of the manganese salt, when the oxidation of the manganese by the gold solutions results in the precipitation of both manganese dioxide and metallic gold. The reaction, however, is slow, and as it proceeds the action of the oxygen of the air comes into play and the deposit of manganese dioxide appears larger and larger as the time of the reaction proceeds. Indeed when a large excess of manganese chloride or sulphate is introduced into an open vessel with calcite and the solution largely diluted to cause the deposition to take place slowly, after several days the calcite is covered with a thick layer of manganese dioxide which contains only a very small amount of gold. When this experiment is repeated with a pure manganese solution and calcite, the formation of manganese dioxide on the calcite crystals and on the sides of the vessel proceeds in exactly the same manner.

That these are the general directions of these reactions is further evidenced by the duplication of exactly the same character of phenomena by replacing the manganese solutions with cerium compounds. Cerous hydroxide precipitates metallic gold in alkaline solution, the cerium being at the same time oxidized to cerium dioxide. Similarly when a piece of calcite is introduced into a solution of cerium chloride and gold chloride, as the acid liberated by the hydrolysis of the cerium salt is neutralized by the calcium carbonate, a deposit of cerium dioxide containing metallic gold begins to form on the calcite. As in the blank experiment with manganese, a pure cerous salt when dissolved in water to a dilute solution, a piece of calcite added and allowed to stand for several days develops a deposit of cerium dioxide on the calcite and on the walls of the vessel.

The presence of gold in the manganese deposits, as observed by W. H. Emmons (see *Transactions American Institute Mining Engineers*, 1910, page 768), may be due to the fact that manganese is a significant agent in the superficial transport of gold, but such is by no means necessarily the case. Several distinct kinds of reactions may be going on. In one case a chloride solution containing free acid coming in contact with an oxidized manganese deposit will produce free chlorine or its equivalent. This chlorine-containing solution can then dissolve gold and cause the production of a gold-bearing manganese solution. This solution, as long as it contains free acid, is permanent, but when it comes in contact with any neutralizing agency, such as a limestone, metallic gold and manganese dioxide would be at once precipitated. Thus the presence of gold in manganese deposits adjacent to other gold deposits may be due to the fact that gold solutions in contact with manganese dioxide yield metallic gold through the principle of auto-reduction that other peroxides show with gold solutions, and it is possible to conceive that the oxygen of the air has been in many instances the real agent causing the gold to be reduced in the presence of a manganese compound that acts as a catalytic agent.

CURRENT LITERATURE

[Copies of the original papers and articles mentioned under this heading can be obtained on application to the Technical Bookshop, Salisbury House, London E.C., the book department of *The Mining Magazine*.]

The Plymouth Mill.—In the *Mining and Scientific Press* for October 31, Gelasio Caetani describes the new metallurgical plant erected at the Plymouth gold mine, Amador county, California, which belongs to an English company recently formed by Bewick, Moreing & Co. The mill marks a deviation from old-established practice on the Mother Lode, in that coarse crushing (4-mesh) is employed in the stamps, with Hardinge mills (60-mesh) below them. The discharge from the Hardinges is first passed over amalgamating plates, then classified into sand and fine sand. The sand is concentrated on Wilfleys and the middling returned to the classifier, and the fine sand goes to Isbell vanners.

Granby Copper-Smelting Plants.—The *Canadian Mining Journal* for November 1 reprints the description of the copper smelters at Grand Forks and Anyox, British Columbia, belonging to the Granby Consolidated Company, written by A. W. G. Wilson, and published in a report on the copper-smelting industries of Canada, issued by the Mines Branch, Ottawa. This report is not obtainable in this country.

Estimation of Mercury.—In the *Engineering and Mining Journal* for October 31, J. E. Clennell describes his volumetric method for the estimation of mercury.

Cottrell Precipitation Process.—The *Mining and Scientific Press* for October 24 records the rapidly extending application of F. C. Cottrell's electrostatic method of precipitating fume and dust. We gave outlines of the process and its history in our issues of October 1911 and April 1914, and the article in our contemporary gives further information of the application of the process.

Petroleum in China.—In the *Mining and Scientific Press* for October 24, T. T. and M. C. Read describe the petroleum, gas, and brine wells of Ssuehuan in Southwestern China. The Chinese have for a long period worked the wells for salt and have developed an elaborate system of drilling. The article is made additionally interesting by the inclusion of sketches made on the spot by Coldre, a French resident missionary.

Lead Salts in Cyanidation.—The *Mining and Scientific Press* for October 24 contains an elaborate article by G. H. Clevenger reviewing recent available information on the function of lead salts in cyanidation. The article is in the nature of a continuation of one written in the same journal for November 15, 1913, by M. W. von Bernewitz.

Coal-dust for Reverberatories.—The *Engineering and Mining Journal* for October 24 contains an article by E. P. Mathewson describing the coal-fired reverberatory furnaces at Anaconda. These furnaces were described in the *Magazine* for September by E. J. Carlyle.

Assaying Slime.—In the *Monthly Journal* of the Chamber of Mines of Western Australia for September, L. R. Benjamin recounts experiments and a method for determining, with a greater degree of accuracy than is usually obtained in present practice, the gold remaining in slime, both the gold in solution and the undissolved gold.

Cyanide Process.—In *Metallurgical and Chemical Engineering* for October, W. J. Pentland makes a proposal for a modification in all-sliming methods, whereby the coarser parts are given an additional agitation in a vat placed in the tube-mill-classifier circuit.

Calumet & Hecla Tailing.—In the *Engineering and Mining Journal* for November 7, L. E. Ives describes the Bucyrus dredge to be used in reclaiming copper-bearing tailing discharged in previous years into the lake by the Calumet & Hecla company. We gave some particulars of this undertaking in our issues of April and October of this year.

Hydraulic Mining Cartridge.—The *Colliery Guardian* for November 6 prints James Tonge's paper read before the Society of Engineers describing the hydraulic mining cartridge.

Nenthead Zinc-Lead Mines.—The *Iron & Coal Trades Review* for October 30 gives particulars, with illustrations, of the zinc-lead mines at Nenthead, near Alston, Cumberland. These mines have been in existence for over a hundred years, and since 1896 they have been operated by the Vieille Montagne company of Belgium.

Iron Ores of Brazil.—The October *Bulletin* of the American Institute of Mining Engineers contains a paper by E. C. Harder on the iron-ore resources of Brazil. This supplements a paper published in *Economic Geology* for November 1911 by the author and C. K. Leith, and abstracted in our *Précis* in the issue of January 1912.

Assay - Furnace.—The October *Bulletin* of the American Institute of Mining Engineers contains a paper by E. A. H. Tays describing a form of assay-furnace employing wood-fuel.

Continuous Decantation.—In the *Mining and Scientific Press* for November 7, Jesse Simmons describes the cyanide practice at the New Reliance mine, Black Hills, Dakota, where continuous decantation is a feature.

Gold Dredging.—In the *Mining and Scientific Press* for November 7, Charles Janin discusses various points in connection with the recovery of gold in dredges. He points to the difficulty of sampling the feed and tailing, and shows that a large proportion of the gold is caught on the first four tables.

NEW BOOKS

Geology of Today. By J. W. Gregory. Cloth, octavo, 330 pages, illustrated. London: Seeley, Service & Co. Price 5s. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Professor Gregory, of the University of Glasgow, is one of our great expositors of knowledge, a learned man with the rare faculty of making advanced thought appear simple, which, as a matter of fact, it really is. Hence though he calls this book a "popular introduction in simple language," we are not served with the futile twaddle usually associated with this label. His "introduction" is not merely to the outer courts of the temple, but to the very holy of holies. Thus we find in these pages clear and concise accounts of advanced and subtle theories, which are usually so wrapped in technical phraseology by their exponents as to be mystifying to the ordinary mining man. For instance he discusses in a manner perfectly intelligible to the ordinary reader the theory of absorption of sedimentary rocks by igneous flows and the ensuing explanation of the wide range of acid and basic constitution of the igneous rocks. Though this theory has of recent years been elaborated by Daly in America and Mennell in England, it has been opposed by other authorities, and does not receive the notice it deserves. Then again Mr. Gregory gives us an outline of Suess's theories of the effects of contraction of the earth's bulk and of the lowering of the sea-level following the sinking of the ocean bed. Little attention is given to Suess in many quarters, owing probably to the ponderous nature of his monograph. We also find in this book a description of Dutton's principle of isostasy as applied to orogeny. We refer to these three instances to show that the book though introductory includes reference to much advanced thought.

The first chapter of the book recapitulates the history of geology. Then follow disquisitions on the birth of the earth, the geology of the inner earth, and the geology of the earth's crust. The author rejects Laplace's nebular theory for Lockyer, Huggins, and Chamberlin's theory based on the agglomeration of meteorites. He shows that since a crust first formed on the earth the temperature of the surface and the atmosphere have not been much different from what they are today, nor has the earth greatly shrunk in size. He outlines Joly's views on radioactivity as it has possibly affected the alterations of heat and cold to which the earth's surface has been subjected from Archæan times. Other chapters deal with earthquakes, volcanoes, orography, the age of the earth, and the dawn of life. The latter half of the book is devoted to palæontology, and traces the evolution of life on the earth. Naturally the Jurassic era of huge reptiles

and birds attracts attention. The size of extinct animals provides interesting reading. The geological history of man forms a suitable terminal chapter, in which the author's accounts of the Ightham flints and the Piltown skull bring the subject fully up to date. It is difficult to lay the book aside, but it contains so much information over so wide a range of subjects, that a cursory reading is not to be recommended. Appearing at this time of the year, its suitability as a Christmas gift immediately suggests itself.

E. W.

Raw Materials for the Enamel Industry. By Julius Grünwald; translated from the German by Herbert H. Hodgson. Cloth, octavo, 230 pages. London: Charles Griffin & Co. Price 8s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Enamelling is at present one of the notable German industries, and we in this country have been in the habit of largely relying on the foreigner for household utensils of this class. It may be that English labour is unsuited to the manufacture of these cheap goods, or that our technologists have not pursued their studies to the same extent as their continental confreres. If the latter is the explanation, the present book, with the author's two previous books on enamelling and tinning, may possibly fill the gaps in the managers' knowledge, and help in the establishment of more enamelled-ware factories in this country. Enamelling is one of the ancient arts, but its application to the production of protective coatings for iron and steel goods is of comparatively recent date. The author has collected facts from various sources relating to the raw materials used in the production of enamels, such as felspar, quartz, fluor-spar, cryolite, clays, borax, tin oxide, oxides of antimony and sodium antimonates, titanite acid, etc.; and to fluxes such as soda and potash, and nitrate of soda. Accounts are given of the chief colouring agents, manganese, cobalt, chromium, iron, etc. A large part of the information relates to the occurrence of these minerals and the method of preparing them for use, but we confess that the presentation of this part of the subject has little attraction to us. Take the chapter on tin, for instance; we can only call it 'laboriously inexact.' We take it that the author is not personally acquainted with the history of his materials before they come to the enameller's laboratory. His treatment of the parts of his subject of direct application in enamelling is, on the contrary, distinctly useful.

What is the Value of a Share? By D. W. Rossiter. Octavo, flexible linen cover, 20 pages. London: Sir Isaac Pitman & Sons. Price 2s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

We have to thank the author for giving the mining investor a useful handbook. The questions continually arise, and reference to them has often been made in our columns, as to the present value of shares expected to yield certain dividends over defined periods, conversely the rate of dividend that would justify the purchase price of shares, and the sinking fund required for the amortization of capital. Those familiar with the principles of finance can answer these questions by reference to Inwood's and Hoskold's Tables, but the average mining engineer or speculator is bewildered at these arrays of figures and finds a difficulty in applying them to his requirements. Mr. Rossiter, who is head of the Intelligence Department in Johannesburg of the Consolidated Gold Fields of South Africa, has prepared condensed tables directly suitable for these cal-

culations. We are sure that they have been helpful in the company's office. We thank him and the company for issuing them in convenient form for everybody's use, and for appending explanations with characteristic examples. We have a recollection that tables on similar lines to Mr. Rossiter's were prepared by Mr. J. Jervis Garrard, but as the sinking-fund rate was taken uniformly at 3%, the tables did not have wide circulation, and they are not now in print.

The old method for finding the present value of shares was first to ascertain three factors, namely: (1) Life of mine (say 20 years); (2) Amount of annual dividends (say at the rate of 20%); (3) Issued capital (say £150,000 in £1 shares). Then to take the basis of the return required on the money invested, say for example 6%, with a sinking fund earning 3%, thus:

$$6\% = 0.06$$

$$\text{Sinking fund page 110, Inwood's} = 0.037216$$

$$\text{£}0.097216$$

This was the sum that should be received every year for 20 years, of which the present value is £1. If therefore the present value of £0.097216 per annum for 20 years is £1, then the present value of £1 per annum for 20 years would be:

$$1 \div 0.097216 = \text{£}10.28637.$$

Having thus obtained the present value of £1 per annum for 20 years, it was necessary to multiply the factor of £10.28637 by the annual sum paid by the company each year in dividends in order to ascertain the present value of such dividends. Thus a company having an issued capital of 150,000 £1 shares, and paying a 20% dividend each year, would pay out annually in dividends £30,000. Therefore, $30,000 \times 10.28637 = \text{£}308,591.1$, which represents the present value of the annual dividends for 20 years. Divide the £308,591.1 by 150,000 (the number of £1 issued shares) to get the present value of a £1 share in the company, in this case the result being £2 1s. 2d. per £1 share, or if we put all the factors together:

$$\frac{1}{0.097216} \times \frac{30,000}{150,000} = \frac{30,000}{14,582.4} = \text{£}2.057274$$

In the above calculations, however, the actual number of issued shares can always be discarded as well as the total dividend amount, and in place thereof the rate per cent of dividend taken, thus:

$$\text{£}10.28637 \times 0.2 = \text{£}2.057274 = \text{£}2 \text{ 1s. 2d. per £1 share.}$$

Later, in 1904, Inwood brought out a fresh edition giving tables under the heading of 'Value of an Annuity' (page 116 onward), the figures in which show the present value of £1 per annum for any number of years. On page 121a is given the above factor of £10.28637. However, to get the present value of a share, even with these new Inwood's tables, it was still necessary to work out this figure. Hoskold's book, 1905 edition, entitled 'Engineers' Valuing Assistant,' also gives similar figures, to a greater number of decimal places than Inwood's.

It is contended by Mr. Rossiter, and we agree, that his new tables are simpler for the ordinary business man. For instance, the life factor given for the same case is 2s. 0.687d., which multiplied by 20 the rate per cent gives 41s. 1.74d.

To ascertain what dividend a share should receive to warrant its price or market value, assuming the investor is satisfied with interest on his money at the rate of 6% per annum and a further sum which put by at 3% compound interest would redeem the amount invested, we give a specific example, the £1 share having a market price of £6, and the life of the mine

20 years. By taking the tables given in Inwood's and Hoskold's books we get :

| | In respect of present value of £1. |
|---|------------------------------------|
| Interest at 6% | = . 0'06 |
| Sinking fund for £1 @ 3% compound interest for 20 years | = . 0'037216 |
| Amount required per annum for 20 years in respect of £1..... | = £0'097216 |

If £0'097216 is required per annum for 20 years in respect of £1, therefore £0'097216 × 6 would be required in respect of £1 share having a market value of £6 = £0'583296. Therefore the rate per cent required to be paid per annum would be £0'583296 × 100 = 58'3296%.

According to Rossiter's Tables, however, take £6 the quotation in shillings, and divide it by the life factor opposite 20 in the tables thus : 120s. ÷ 2s. 0'687d. = 58'33% per annum. Rossiter's method is thus seen to be extraordinarily simple.

We have given a large amount of space to the review of this book, especially in that part devoted to the methods required when using Inwood's and Hoskold's tables. The spaces occupied by the explanation of the calculations by means of these and Rossiter's respectively may be taken as indicative of the relative simplicity of the new tables. In any case, we hope that the description of the method of using Inwood's and Hoskold's Tables will prove useful to those of our readers who are in search of instruction.

Pumping by Compressed Air. By Edmund M. Ivens. Cloth, octavo, 250 pages, illustrated. New York : John Wiley & Sons; London : Chapman & Hall. Price 12s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book is primarily intended for the civil engineer, but it is applicable in a great variety of ways to the work of the mining engineer and metallurgist. For instance, the first chapter shows that the use of compressed air in place of steam for operating direct-acting plunger-pumps, while the second describes the displacement pump, in which compressed air acts directly on the water. Examples of its application in mining are given. The return-air system is the most modern improvement in the direct-action method, and in illustration the author gives lengthy details of the installation built on this system at one of the shafts of the Croton aqueduct which supplies New York with water. Three chapters are devoted to the air-lift, and several systems are described. The remainder of the book is devoted to scientific principles relating to air-compression and the flow of compressed air in pipes. The author writes at first hand, and is an engineer of great experience in this branch of pumping.

The Mine Wagon and its Lubrication. By Caleb Pamey. Cloth, octavo, 110 pages, illustrated. London : Crosby Lockwood & Son. Price 7s. 6d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

Mr. Pamey is well known as the author of the 'Colliery Manager's Handbook' published some years ago. In his new book he gives us much detail relating to a humble but important department of mining practice, describing the various kinds of wagon and their special applications. During the last two years attention has been drawn to the design of wagons, owing to the regulations now in force for the prevention of the scattering of dust throughout the workings in coal mines.

Laboratory Course in Electrochemistry. By Oliver P. Watts. Cloth, octavo, 150 pages. New York : McGraw-Hill Book Co. Price 4s. 2d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

This book contains the course of instruction used by the author, who is assistant professor of applied electrochemistry in the University of Wisconsin.

Crystallography. By T. L. Walker. Cloth, octavo, 210 pages, illustrated. New York : McGraw-Hill Book Co. Price 8s. 4d. net. For sale at the Technical Bookshop of *The Mining Magazine*.

The author is professor of mineralogy and petrography in the University of Toronto, and he has for many years adopted the gnomonic projection methods of Victor Goldschmidt, of Heidelberg. This book embodies the author's lectures, and, as far as we know, constitutes the first English rendering of Goldschmidt's system.

COMPANY REPORTS

Sheba Gold.—This company was formed in 1884 to acquire a group of gold-mining properties in the Barberton district of the Transvaal. Dividends were paid from 1891 to 1898, but subsequently there came a series of disappointing years. In 1904 the company was reconstructed, and in 1911 the capital was reduced by the nominal value of the shares being altered from £1 to 5s. Five years ago it was decided to modify the policy at the properties, and to concentrate attention on a few mines, instead of spreading the work over large areas. The new policy has been successful, and dividends have been paid regularly since. The report for the year ended June 30 shows that 74,965 tons of ore averaging 13 dwt. gold per ton was raised and treated, 66,071 tons coming from the Zwartkopje mine. The yield of gold was 38,932 oz., worth £164,713. This was a recovery of 83%, a figure lower than usual, due to the increased refractoriness of the ore. The working profit for the year was £49,549, out of which £6109 was paid as profits tax, £3335 allowed for depreciation, and £40,460 distributed as dividend, being at the rate of 15%. H. B. White, the manager, reports that the total ore reserve at five properties was 101,500 tons averaging 11 dwt. per ton, of which 30,000 tons was at the Zwartkopje, and 50,000 tons at the Intombi. These figures show a slight reduction as compared with the previous year. At the Zwartkopje no ore has been disclosed during the year on the lowest levels, the 8th and 9th. On the other hand, the developments at the Intombi have been satisfactory.

Glynn's Lydenburg.—This company was formed in 1895 to acquire a gold mine on the Sabie river near Pilgrim's Rest, in the Lydenburg district of the Transvaal. The control is with the Central Mining group, and G. C. Damant is manager. Milling started in 1897 with 10 stamps, and profits have been made continuously. The plant now contains 20 stamps and 1 tube-mill. The lode is nearly flat, and is on a spur of a hill, so that it can be worked at many points by adit. Its width is about 12 in. and the assay value averages 10 dwt. The report for the year ended July 31 shows that the reserve on the Mill Hill property, which has hitherto supplied most of the ore, is rapidly decreasing, and that the future of the company depends on the Werf mynpacht. The latter is being vigorously prospected with results not too good, though the most recent reports are more hopeful. During the year under review, 45,918 tons was sent to the mill, where 7423 oz.

gold was extracted by amalgamation and 16,419 oz. by cyanide, a total of 23,842 oz., worth £100,433, or 43s. 9d. per ton. The working cost was £49,915 or 21s. 9d. per ton, leaving a working profit of £50,518 or 22s. per ton. Out of the profit £5343 was paid as profits tax, and £34,000 was distributed as dividend, being at the rate of 20 per cent.

Pigg's Peak Development.—This company was formed in 1889 to acquire a tract of country near Pigg's Peak in Swaziland, South Africa. Operations have been confined to the Peak gold mine, which has not so far proved a profitable venture. There have been two reconstructions, the last in 1898 when L. Ehrlich & Co. assumed control, with E. T. McCarthy as consulting engineer. In addition to these reconstructions, additional funds were subscribed on two

Messina (Transvaal) Development.—This company was formed by A. M. Grenfell in 1905 to acquire a copper property consisting of ancient mine-workings in the north of the Transvaal close to the Rhodesian border. The ore developed at first was of high grade and much of it was picked and sent to Swansea, but owing to the absence of railway facilities, the cost of transport prevented profits being earned. Concentrating plant was first erected in 1909, and has recently been greatly extended, the concentrate also being shipped to Swansea. The first smelting furnace was put into commission in 1913 to treat middling. The railway connecting with the Pietersburg-Pretoria system was completed in 1913. The issued capital of the company is £181,788 in 5s. shares, and there are £250,000 debentures, the interest on which was guaran-



MAP OF EASTERN TRANSVAAL, SHOWING POSITION OF BARBERTON, PIGG'S PEAK, AND PILGRIM'S REST GOLDFIELDS.

occasions, in 1905 and 1909. The issued capital is now £223,225, and there are £15,625 debentures outstanding. The report for the year ended March 31 last shows that 31,700 tons of ore was mined and sent to the mill averaging 8 dwt. gold per ton. Of this, 25,308 tons came from the old section averaging 7 dwt., and 6392 tons from the new section averaging 12 dwt. The gold sold for £49,535, and the working cost was £29,034, leaving a working profit of £20,501. After allowance for depreciation and administration expenses, the net profit was £10,065, which is carried forward. Debentures to the value of £5100 have been redeemed during the year. The ore reserve was estimated on March 31 at 58,490 tons in the old section averaging 5.8 dwt. per ton, and 12,938 tons in the new section averaging 14 dwt. per ton.

teed by the Camp Bird company in return for options on unissued shares. No dividend on the share capital has been paid. The financial collapse of Mr. Grenfell, who had been continuously the chairman and controller, in June last, led to a change in the directorate, and H. C. Hoover is now the dominant figure on the board, as he is in the case of the Camp Bird and Santa Gertrudis. The report for the year ended June 30 shows that the company's cash resources to the extent of £183,000 had been placed on loan to the Canadian Agency, Mr. Grenfell's promoting company, while £14,967 was with Chaplin, Milne, Grenfell & Co. The failure of these two companies necessitated the raising of funds for continuing the finance of the mine. This was effected by loans from the bankers, and by guarantee by interested parties. During the

year, 58,812 tons of ore was sent to the concentrating plant, averaging 8.3% copper. Most of this came from the Bonanza section of the North lode, on the 2nd, 3rd, and 4th levels. The concentrate produced amounted to 10,167 tons averaging 40.7% copper, of which all but 199 tons was shipped to Swansea. The 199 tons together with 3043 tons of old middling was smelted on the spot for a yield of 743 tons of matte averaging 58% copper. With regard to the disposal of the concentrate in future, R. J. Frecheville and W. G. Perkins recommend the erection of additional smelting furnaces and a converting plant for the purpose of treating everything on the spot and producing fine copper. The cost of such a plant would be £40,000 and the saving should be 12s. per ton of ore treated. As regards development, J. M. Calderwood, the consulting engineer, reports that the 10th level is being opened and that the limits of the orebodies have not been ascertained either laterally or in depth. The ore now being exposed consists of rich bunches of chalcocite, but the necessary inclusion of poorer lode-matter in mining these bunches brings the average assay of the ore developed during the year down to 4.1% over 60 in., as compared with 10.9% during the previous year. The reserve was estimated on June 30 at 252,000 tons, averaging between 8 and 9% copper. In addition 140,000 tons is reported as probable ore between the 9th and 10th levels. The accounts show an income of £219,752 from the sale of concentrate and a working profit of £63,781. Out of the profit £15,000 was paid as debenture interest and £3600 as profits tax. The remainder was written off against the loss of deposit money recorded above.

Jumbo Gold.—This company belongs to the Lewis & Marks group and was formed in 1906 to acquire a gold mine in the Mazoe valley, Rhodesia, 30 miles north of Salisbury. From the commencement of milling in 1906 to the middle of 1913, the yield was 123,393 oz. from 243,577 tons of ore, but no dividend was ever paid. Two years ago the orebodies began to show signs of imminent exhaustion, and development was discontinued. A resumption was made in March 1913 and further limited supplies of ore were found. The report for the year ended June 30 shows that 37,800 tons of ore was treated for a yield of 11,816 oz. gold worth £50,218, at a working cost of £44,310. Cyril E. Parsons, the engineer, wisely calls the figure obtained by subtracting the working cost from the yield the 'difference,' not a 'profit.' The accounts show £10,657 charged for depreciation, and £18,900 for development redemption, so that the eventual result of the year's work was an adverse balance of £24,147. Mr. Parsons reports that the number of points from which ore can be stoped has diminished, and it is not possible now to employ more than 10 out of the 30 stamps. Other orebodies might be found by further development, but the cost of such work would probably not be recovered, so when the present stopes are exhausted the proposition is to let the mine on tribute.

Selukwe Columbia Gold.—This company belongs to the Gold Fields Rhodesian Development group, the control having been transferred three years ago from the Rhodesian Exploration & Development Co. It was floated in 1900 to acquire the Yankee Doodle property in the Selukwe district of Rhodesia. On four occasions reconstruction has been necessary, in order to raise additional funds. A dividend of 10% was paid in 1911. In 1912 the mine began to show signs of exhaustion, and additional properties were bought, called the Wonderland, Chimborazo, and Danga, situated in the Gwelo district a short distance to the north.

The report for the year ended June 30 shows that work ceased at the Yankee Doodle at the end of November 1913, and that the mine has been let on tribute. During the five months, July to November, the mill treated 10,020 tons for a yield of 6331 oz. worth £26,985, including the returns from the final clean-up. The working cost was £15,566, so a working profit of £11,419 was left. The tributaries commenced milling in March with 10 stamps, and during the period ended June 30 had treated 6015 tons for a yield of gold worth £7957, being an extraction of 6.3 dwt. per ton. It is stated that a large amount of ore of this grade is available. The company's royalty on the output was £745. The tributaries are stacking the slime for future treatment. During the year, 4378 ft. of development was done, at a cost of £18,688, and the reserve on June 30 was estimated at 20,000 tons averaging 11 dwt. This figure had been brought to 30,000 tons by the end of October. The outlook is sufficiently favourable to warrant the erection of a 10-stamp mill and a sand-plant. The accounts show a profit at the Yankee Doodle of £9579, after due allowance for administration expenses and depreciation of plant. The development at Wonderland is being met out of capital subscribed in 1912. The year started with a balance of £19,621, so the sum available for distribution was £29,200. A dividend of 15% was unexpectedly announced at the meeting, the amount represented being £21,036.

Wankie Colliery.—This company is in the control of the British South Africa Co., and was formed in 1899 to develop coal deposits in Southern Rhodesia, between Bulawayo and Victoria Falls. We gave an account of these deposits in our issue of May last. The report for the year ended August 31 last shows that the prosperity of the company is advancing rapidly. During this period, 239,969 tons of coal and 17,272 tons of coke were sold, together with fire-clay and bricks, bringing an income of £144,901. The balance of profit was £56,236, and £50,654 was distributed as dividend, being at the rate of 25%. Moreover, £20,000 debentures were redeemed. One of the best customers is the Union Minière du Haut Katanga, for coal and coke required at the copper mines and smelters in the Belgian Congo. The new contract with this company commencing next year calls for the supply over ten years of not less than 60,000 tons of coal and 40,000 tons of coke per year, and also fire-clay and bricks. During the past year the installation of bee-hive coke-ovens has been extended, and plans for additional ovens of the Coppée type are in hand. When these are completed the plant will consist of 49 bee-hives and 44 Coppées, the total capacity being about 70,000 tons of coke per year. To provide additional funds for this addition to the plant, £60,000 new debentures have been issued. The outstanding debentures now amount to £100,000, and the arrangement is to redeem £7000 every year. It is proposed to expand the capital of the company by issuing two 10s. shares for every one 10s. share now in existence. In this way the nominal value of the shares held by each individual will be restored to what it was before the reconstruction in 1909 when the par value of the shares was written down from £1 to 10 shillings.

Taquah Mining & Exploration.—This company was originally formed in 1888 as the Taquah & Abosso Gold Mining Co., to acquire gold mining properties in the Tarkwa district, West Africa. In 1901 the company was divided, the Abosso mine being transferred to a subsidiary. The only dividend paid by the Taquah company until this year was distributed in 1909. Milling was suspended for a year from the middle of 1910. The control passed four years ago to the Oceana Con-

solidated, which provided additional working capital on loan. J. W. Newbery, the manager, has joined the King's forces, and has been succeeded by G. W. Campion. The report for the year ended June 30 shows that 58,746 tons of ore averaging 67s. 3d. per ton was sent to the mill, and the yield was 42,149 oz. worth £178,812, or 60s. 10d. per ton. The working cost was £114,872 or 39s. 1d. per ton, a figure rather higher than during the previous year, caused by an accident to the power-plant and its necessary remodeling. After allowing £26,543 for depreciation, and receiving £6357 as dividend from the Abosso company, a balance of £43,821 was left. Out of this, £19,373 has been paid as dividend, being at the rate of 5%, and £10,839 has been applied to still further reducing the book-value of old plant and of debentures in the Ancobra Exploration & Dredging Co. Development during the year has maintained the ore reserve, which stood on June 30 at 191,279 tons averaging 61s. per ton. Additional plant for treating slime and concentrate is being erected; the accumulation of these materials awaiting treatment total 40,870 tons averaging about 9 dwt. gold per ton.

Abosso Gold.—As recorded in the preceding paragraph, this company is a subsidiary of the Taquah Mining & Exploration Co. The report for the year ended June 30 shows that 88,381 tons of ore was raised and treated averaging 39s. 5d. per ton, for a yield of 36,139 oz. gold worth £153,262 or 34s. 8d. per ton. In addition the mill treated 18,156 tons of custom ore from the Cinnamon Bippo mine. The working cost was £122,867 or 27s. 9d. per ton. After allowing £16,396 for depreciation, etc., and paying taxes and law costs, a profit of £13,204 remained, to which is added the balance brought forward from the previous year, making a disposable balance of £46,701. Out of this, £20,000 has been distributed as dividend, being at the rate of 5%. J. G. McKinley, the manager, reports that the ore reserve has been well maintained and stood on June 30 at 270,720 tons averaging 34s. 7d. per ton. The extensions of slime-treatment and power plant have been completed. The accumulations of slime amount to 65,000 tons averaging 9s. 6d. per ton.

Amalgamated Zinc (De Bavay's).—This company is registered in Melbourne and operates the De Bavay flotation process, treating the zinc tailing produced at the North, South, and Block 10 mines. It also holds shares in the Minerals Separation & De Bavay's Processes Australia Proprietary Limited, a company formed to pool the royalties accruing from the two processes in Australia. W. L. Baillieu is chairman and H. W. Gepp is manager. The report for the half-year ended June 30 shows that 247,386 tons of tailing of unspecified content was treated, yielding 69,918 tons of zinc concentrate averaging 48·6% zinc, 6·1% lead, and 8·9 oz. silver per ton, together with 687 tons of lead concentrate averaging 53·5% lead, 14·1% zinc, and 53·1 oz. silver. In the accounts, the price of zinc is taken at £21 per ton, and on that basis the working profit was £61,986. In this total is included £5471, the excess of profit over that estimated for the previous half-year, and also £8447, the profit derived from 10,128 tons of concentrate produced in 1910 but only delivered during the half-year under review. Administration expenses and taxes reduced the profit to £58,579, out of which £6603 was also written off for depreciation, and £50,000 was distributed as dividend. Arrangements have been made to take £22 as the price of zinc in finally fixing the price of concentrate delivered during the half-year, so that a further profit of about £10,000 should accrue. At the present time the

plant is being operated on a scale sufficient to treat the current tailing from the mines, that is to say, at about half the capacity. The concentrate is being stacked awaiting a market. As the company has funds in hand, this policy can be continued for a time, but unless the war is over soon operations will have to be suspended.

British Broken Hill.—This company was formed in 1887 to purchase Blocks 15 and 16 from the Broken Hill Proprietary. The purchase price was £675,000 in cash and £400,000 in shares, but the mine has never lived up to this capitalization, for the dividends have not been more than 33% of the original capital, £1,200,000. In 1890 additional capital was raised by the issue of 60,000 privileged shares of £2 each, ranking equally for dividends with the £5 shares. In 1895 the capital was reduced to £264,000 by scaling down each share to one fifth of its original nominal value. In 1912 a new lode was discovered and 60,000 shares nominally worth £1 were issued at 50s. in order to provide working capital for development. On two occasions the low price of metals has made it necessary to suspend mining, the last time being in 1909-10. On resumption in 1910, an Elmore plant was erected to treat zinc tailing, but was shortly afterward discarded. A Minerals Separation plant has since been built, and several improvements have also been made in the lead-concentration plant. The report for the half-year ended June 30 last shows that the output was the largest on record, 109,438 tons averaging 12·9% lead, 11·5% zinc, and 7·3 oz. silver per ton being sent to the mill. The yield of lead concentrate was 16,515 tons averaging 61·6% lead, 7·6% zinc, and 24·8 oz. silver per ton. At the zinc plant, 84,062 tons of tailing averaging 12·2% zinc, 3·7% lead, and 3·7 oz. silver per ton was treated, for a yield of 16,310 tons of zinc concentrate averaging 42·4% zinc, 11·6% lead, and 11·2 oz. silver per ton. Development of the new orebody has been continued on Levels 3 to 11, in all of which ore is being disclosed, several runs of ore being found having a higher content of lead than that sent to the mill. The accounts show an income from the sale of lead concentrate of £139,432 and of zinc concentrate of £29,523, and a net profit of £30,994. The sum of £45,000 has been distributed as dividend, being at the rate of 1s. per share, partly out of profits brought forward from the previous half-year. At the outbreak of war the contract with German buyers of concentrate was terminated. The company found it impossible to continue operations without a market for its product, so the mine has been closed.

Yuanmi Gold Mines.—This company was formed in April 1911 to acquire, from the Lake View Consols, the Yuanmi gold mine, which is situated in the East Murchison district of West Australia. In November of the same year the property of the Oroya Black Range company, belonging to the same group, was purchased; this property is at Sandstone, 60 miles north of Yuanmi. T. J. Hoover is chairman of the board, James Brothers are the consulting engineers, Bewick, Moreing & Co. are the general managers, and H. G. Walton is mine superintendent. The report for the year ended June 30 shows that the Black Range mine is practically exhausted. During the period, 54,629 tons was raised and treated for a yield of 20,652 oz. gold worth £87,877. The working cost was £64,700, and £8949 was spent on capital account on development. At the Yuanmi no further supplies of oxidized ore were found, and the reserve is estimated at 9235 tons averaging 31s. 5d. per ton. The reserve of sulphide ore has not been maintained, standing at 29,635

tons as compared with 47,903 tons the year before. The metallurgical plant to treat the sulphide ore was started in September 1913, employing ball-mills, roasting furnaces, and all-slime cyanide plant. The capacity of the roasters has not come up to expectation, but the percentage of recovery at 84% was rather higher than expected. During the year, 59,094 tons was treated, for a yield of 22,036 oz. gold worth £93,460. The working cost was £58,315, and £16,886 was spent on capital account for development and construction. Sinking of the main shaft below the 5th level was commenced in June, but labour troubles have prevented much being done. The working profit at the two mines totalled £32,486. Out of this, £3212 was spent on administration, and £22,362 was allowed for depreciation. With other small items of income, the net balance of profit for the year was £11,889. The shareholders received £17,500, being at the rate of 5%, paid partly out of the balance brought forward from the previous year. A year ago the dividend was at the rate of 12½ per cent.

Kalgurli Gold.—This company was formed in 1897 to acquire property at Kalgoorlie, Western Australia. The report for the year ended July 31 last shows that 127,870 tons of ore was treated, for a yield of gold worth £255,748. These figures are almost identical with those of the two previous years, but the yield per ton is much lower than during earlier periods. The net profit was £101,329, out of which £96,000 was distributed as dividends, being at the rate of 80%. The total production of gold to date has been £3,604,691, obtained from 1,348,290 tons of ore, while £1,444,500 has been distributed as dividend. R. S. Black, the manager, estimates the reserve of ore at 200,000 tons, as compared with 250,000 tons the year before. Diamond drilling below the deepest level, at 1850 ft., undertaken on the advice of J. Malcolm MacLaren, has disclosed no additional supplies of ore.

Mount Elliott.—This company was formed in London in 1907 to acquire the Mount Elliott copper mine, at Selwyn, 70 miles south of Cloncurry, North Queensland. W. H. Corbould is manager. A smelter was built, and was started in 1910. Two years ago, developments in the mine began to be disappointing, and no ore of high grade has been disclosed below the 4th level. The Consols mine, on the same lode as the Hampden mine belonging to the Hampden Cloncurry company, was acquired shortly afterward. During the past year a group of properties belonging to the Queensland Freehold Co. has been purchased, and a company called the Dobbin & Cloncurry Mines has been formed to work them. The policy is to obtain further interests in new properties, and if necessary to move the smelter. The report for the year ended June 30 last shows that 38,875 tons of ore was mined and smelted, yielding 4171 tons of blister copper, containing 4134 tons of pure copper, 4334 oz. gold, and 7497 oz. silver. Smelting was discontinued on May 31 as sufficient ore could not be raised to keep the smelter going regularly. The blister sold during the year brought an income of £290,240, and after all expenses were paid, a profit of £54,023 remained. Out of this, £36,879 has been distributed as dividend, being at the rate of 5%. The remaining proved and probable ore at the Mount Elliott and Selwyn mines is estimated at 33,750 tons averaging 11% copper. The mines and dumps contain half a million tons of material averaging 3% copper, but this cannot be classed as ore under present conditions. Attached to the directors' report is a report made by Count de Venancourt on the mines of the company and its new subsidiary, made at the request of the French shareholders.

Stratton's Independence.—We have on many occasions referred to the history of the Independence gold mine at Cripple Creek, Colorado, and need not recapitulate here. During the last few years, operations have been confined to re-treating the tailing dumps according to a method devised by Philip Argall, and the removal from the workings of any remaining high-grade ore by the company and by tributers. The report for the year ended June 30 last shows that 3899 tons of ore was shipped to smelters on the company's account and 7783 tons on the lessee's account, realizing £14,173 and £33,114 respectively gross, or £9651 and £22,782 net after payment of treatment expenses and freight. The royalty accruing to the company on the lessees' ore was £7280. At the mill and cyanide plant, 45,683 tons of low-grade ore from the mine and 88,192 tons of dump tailing were treated, yielding 7654 oz. gold in concentrate, which was shipped to smelters, and 7764 oz. in bullion, making a total extraction of 15,418 oz. or 2·3 dwt. per ton. The profit on milling and cyaniding was £20,995. After all expenses were paid, a profit of £19,136 remained, out of which £6500 has been distributed as dividend, being at the rate of 5%. It is expected that the mine will continue to yield shipping ore, but on a smaller scale, and that low-grade ore and dump material will keep the treatment-plant occupied for two years. Negotiations were in hand before the war for the acquisition of a new property, but all efforts in this direction are now suspended.

Pena Copper Mines.—This company was formed in 1900 to acquire a copper and sulphur mine in the Huelva district, in the south of Spain, that had previously been worked by a Belgian company. The control is in Germany; and Heinrich Schreck is manager. The issued capital is £537,600, and during the four years 1903 to 1906 dividends of 5, 5, 4, and 7½% were paid. During 1909 extra money had to be spent on removal of overburden, and in 1910 and 1911 profits were diverted to the defence of an action brought against the company by the Rio Tinto Co. in connection with the contract for marketing the products, and also to the construction of a new railway that will make the company independent of the Rio Tinto. The report for the year 1913, just issued, shows that deliveries of ore from the mine were entirely suspended owing to lack of transport. The railway was completed since the close of the period under review and the line was opened in August of this year. The precipitate shipped contained 703 tons of copper, and there was also shipped out of stock at the port 977 tons of cupreous pyrite and 4757 tons of washed pyrite. These shipments of ore were only about 7% of the normal. The trading profit was £11,560, but from this had to be deducted £8283 for depreciation, £6471 for administration and taxes, £445 for debenture interest, and £8900 for redemption of the remaining debentures, so that the profit and loss account showed a debit of £12,540. Under the circumstances related, the position is not unsatisfactory. During the year development was actively continued, and the 12th level was opened. The orebody had two years ago been shown to be much faulted on this level; subsequent exploration has, however, proved that the orebody continues in depth. The amount of ore raised was 68,759 tons, as compared with 84,698 tons the year before. The whole of this was sent to the washing floors. The ore now in course of washing is 580,802 tons. Two of the directors, N. Brückner and H. Schmitz, being Germans, have ceased to be members of the board, and two other directors, C. C. d'Anvers and M. Paisant, are with the French army.

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